GENERAL LIBRARY
JAN 7 1921
UNIV. OF MICH.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

JAN 7 1921

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

No. 2669, Vol. 106] THURSDAY, DECEMBER 23, 1920 [Price One Shilling

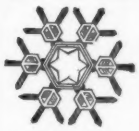
Registered as a Newspaper at the General Post Office]

[All Rights Reserved.

BALANCES & WEIGHTS

F.E.BECKER & Cº
W. & J.GEORGE (LONDON) Ltd PROPRIETORS
17 TO 29 HATTON WALL, LONDON, E.C.1

CHEMICALS
Analytical, Technical and A.R.
REGD. TRADE MARK **APPARATUS**



A SNOW CRYSTAL

Balances
BENCHES
Fume Chambers, etc.,
for
Chemical, Physical and Technical Laboratories

Price Lists and Estimates on Application.

REYNOLDS & BRANSON, LTD.,
Contractors to the War Office, Admiralty and Egyptian Government, &c.
14 COMMERCIAL STREET, LEEDS.

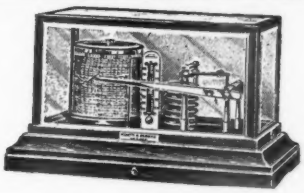
Graphite-Selenium Cells
FOURNIER D'ALBE'S PATTERN.
Great Stability and High Efficiency.

With a sensitive Se surface of 5 sq. cm. and a voltage 20 the additional current obtainable at various illuminations (in metre-candles) is :—

At	1 m.c.	½	milliamp.
At	50 „	1	„
At	500 „	2	„

For particulars and prices apply to the SOLE AGENTS :

John J. Griffin & Sons,
Makers of Physical and Electrical Apparatus,
Kemble Street, KINGSWAY,
LONDON, W.C. 2



Recording Barometers

Latest Price List "N.R.B.," giving particulars of our Patent "Straight Line" and other new patterns, will be gladly forwarded on request.

NEGRETTI & ZAMBRA
38, HOLBORN VIADUCT, E.C.1.
5, LEADENHALL ST, E.C.3.
122, REGENT STREET, W.1.

NOTICE

In consequence of the Christmas Holidays

NATURE

for next week will be published on FRIDAY instead of on Thursday,

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, W.C.2

LECTURES. SESSION 1920–1921.

FIRST COURSE.

ROYAL INSTITUTION OF GREAT BRITAIN,

ALBEMARLE STREET, PICCADILLY, W. 1.

PROFESSOR J. ARTHUR THOMSON, LL.D., will deliver a Christmas Course of Six Illustrated Lectures (adapted to a Juvenile Auditory) on "THE HAUNTS OF LIFE." "THE SCHOOL OF THE SHORE," Thursday, Dec. 30, at Three o'clock; "THE OPEN SEA," Saturday, Jan 1; "THE GREAT DEEPS," Tuesday, Jan. 4; "THE FRESHWATERS," Thursday, Jan. 6; "THE CONQUEST OF THE LAND," Saturday, Jan. 8; "THE MASTERY OF THE AIR," Tuesday, Jan. 11.

Subscription (for non-members) to this Course, One Guinea (Juveniles under sixteen Half-a-Guinea); to all Courses in the Session, Four Guineas. Tickets may be obtained at the Office of the Institution.

UNIVERSITY OF LONDON.

GRAHAM SCHOLARSHIP IN PATHOLOGY.

The Senate of the University of London invite applications for the GRAHAM SCHOLARSHIP in PATHOLOGY, value £400 per annum for two years, founded under the will of the late Dr. Charles Graham to enable a "young man to continue his pathological researches, and at the same time to secure his services to the School of Advanced Medical Studies connected with University College Hospital as a Teacher under the direction of the Professor of Pathology."

The successful candidate will be expected to take up the Scholarship as early as possible in the new year. Intending applicants who desire fuller information of the conditions on which the Scholarship will be held may call personally on the Professor of Pathology, University College Hospital Medical School, W.C. 1. The Scholarship is in no way restricted to students either of University College Hospital Medical School or any other Medical School of the University of London.

Applications, addressed to the PRINCIPAL OFFICER, University of London, South Kensington, S.W. 7, must (*a*) be accompanied by the names of not more than three references, one at least of which should be the name of some Professor, Lecturer, or Teacher of the University or College in which the candidate has conducted his studies in Pathology, (*b*) state the research upon which the applicant proposes to work, and (*c*) be received *not later than the first post on Monday, January 17, 1921.* Envelopes should be marked "Graham Scholarship."

E. C. PERRY, Principal Officer.

BEDFORD COLLEGE FOR WOMEN.

(UNIVERSITY OF LONDON.)

REGENT'S PARK, N.W.1.

SCHOLARSHIP IN SOCIOLOGY.

The Council of Bedford College invite applications for the above SCHOLARSHIP, tenable at Bedford College. The Scholarship, value £80 a year for two years, is open to women holding a University degree or its equivalent. Latest date for receiving applications January 15, 1921. For further information apply the SECRETARY, Bedford College, N.W.1.

UNIVERSITY OF LONDON, KING'S COLLEGE.

DEPARTMENT OF BACTERIOLOGY.

EVENING CLASS.

JANUARY TO MARCH.

A Course on practical and clinical Bacteriology consisting of nine lectures. Demonstrations and practical work will be held on Tuesday evening, 6 to 8, commencing January 18. Fee £4 4*s.* 0*d.* Names should be sent in as soon as possible to the SECRETARY.

SOUTH-WESTERN POLYTECHNIC INSTITUTE,

CHELSEA, S.W. 3.

Day and Evening Courses in Science under Recognised Teachers of London University.

I. INDUSTRIAL CHEMISTRY DEPARTMENT.

Technical Courses in Analytical and Manufacturing Chemistry, Pharmacy, Food and Drugs, A.I.C. Courses, Metallurgy, Assaying, Foundry Work, Research.

II. INDUSTRIAL PHYSICS DEPARTMENT.

Practical work in General Physics, Applications to Industries, Metrology, Calorimetry, Illumination, Acoustics, Electrical Measurement, Research.

III. BIOLOGICAL AND GEOLOGICAL DEPARTMENT.

Courses for B.Sc., etc., in Botany, Geology, Mineralogy, Zoology Special Courses in Bio-chemistry, Bio-physics, Bacteriology, Physiology, Hygiene, Entomology, Plant Pathology. Course for Tropical Planters, Research.

SIDNEY SKINNER, M.A., Principal.

Telephone: Kensington 899.

BOMBAY SCHOOL OF TROPICAL MEDICINE.

The Tropical Diseases Committee of the Royal Society, acting for the Indian Government, invite applications for the post of TATA PROFESSORS of (1) Clinical Medicine and Therapy; (2) Protozoology for the School and Hospital of Tropical Medicine, about to be established in Bombay.

The salary will be, in each case, from 1,500 to 3,000 rupees a month, according to the scientific standing of the candidates.

The appointments are whole-time, and are made for five years in the first instance, but may be extended by the Government on the recommendation of the Governing Body of the School. No pension is attached, but the Professors will be given the benefit of a contributory provident fund fixed by the Government of Bombay. Furlough for six months out of India on full pay will be granted for every period of five years, and, in addition, "study leave" on furlough pay may be granted.

Applications, which should specify age, qualifications, and tropical and other experience, must reach the SECRETARY, the Royal Society, Burlington House, London, W., not later than March 31, 1921. The names and addresses of three persons to whom reference may be made should be given, and candidates may submit copies of testimonials.

EGYPTIAN GOVERNMENT SCHOOL OF MEDICINE.

The post of PROFESSOR of CHEMISTRY is vacant owing to the appointment of the present holder as Professor of Chemistry in the University of London.

The salary is L.E. 1000–1200 (L.E. 1 = £1 0 6) together with certain temporary increases which bring the initial salary at present to L.E. 1300.

Pension and leave are calculated under the rules governing the rest of the Egyptian Civil Service.

Applications, with personal references and details of experience in teaching and research (five copies of each document), should be addressed in the first instance to the DIRECTOR, Egyptian Educational Mission, 28 Victoria Street, Westminster, S.W. 1, by whom they will be forwarded to the Selection Board formed in England. No communications should be addressed to Cairo.

Information as to conditions of tenure can be obtained on application.

The pay will begin from time of arrival in Cairo. One month's pay in lieu of passage money will be granted.

Applications must be made before January 31, 1921.

THE INSTITUTION OF MECHANICAL ENGINEERS.

CUTTING TOOLS RESEARCH COMMITTEE.

APPOINTMENT OF RESEARCH ASSISTANT.

An extensive programme of Research has been drawn up by the Cutting Tools Research Committee of the Institution, and it is proposed to appoint a whole-time RESEARCH ASSISTANT to supervise the experimental work which will be carried out, and to compile reports for the Committee. The salary offered is at the rate of £700 per annum, and travelling expenses, under certain conditions, will be defrayed. Applications for the appointment are invited from persons who possess the necessary scientific and practical qualifications: they should be addressed, not later than December 31, 1920, to the SECRETARY, Institution of Mechanical Engineers, Storey's Gate, St. James's Park, Westminster, S.W.1 (marked "Research Assistant"), and should give full details of the candidate's general and technical education and experience in mechanical engineering and research work. A candidate should give the names of three engineers of standing who can speak with authority as to his character and technical ability. Further particulars of the appointment can be obtained on application.

UNIVERSITY OF LONDON.

The Senate invite applications for the UNIVERSITY READERSHIP in BIOLOGY tenable in King's College for Women Household and Social Science Department. Salary £500 a year. Applications (12 copies) must be received not later than first post on January 1, 1921, by the ACADEMIC REGISTRAR, University of London, South Kensington, S.W.7, from whom further particulars may be obtained.

THURSDAY, DECEMBER 23, 1920.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.

Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

The Dyestuffs Bill.

THE Dyestuffs (Import Regulation) Bill passed its third reading in the House of Commons on December 17 by a majority of 86 (111 votes to 25), after the Opposition had unsuccessfully challenged a division on the Government's motion to exempt the measure from the limitations of the Standing Order relating to a Friday sitting. This action on the part of the Opposition is an indication of the attitude of a certain section of the Manchester school of political economists towards the Bill; in so far as it savours of Protection, it is, of course, anathema. Their ears were apparently deaf to all arguments as to the absolute necessity of resuscitating, as much in the interests of our national security as in those of our commercial prosperity, an industry primarily of British origin. The old theoretical Free Trade arguments against the Bill failed, however, to convince all Free Traders in the House. The member for the Bridgeton division of Glasgow, as a Free Trader, had the temerity to denounce the agitation against the measure as wholly factious and bogus and as doing the greatest harm to the cause of Free Trade.

A perusal of the proceedings of Standing Committee B, which was charged with the consideration of the Bill, serves to confirm this impression. Under cover of protecting the interests of the textile and other colour-using industries, an amendment was moved which, without materially benefiting these industries, could only result in limiting the beneficent intention of the Bill as regards the dye-makers. The mover of the amendment scored one or two debating points, but the suggestion to add words to the particular subsection which prohibits importation of dyestuffs so as to imply that the safeguarding of the dye-making industry was being done at the expense of the textile industries so little commended itself to the judgment of the Committee that it was rejected by a majority of more than two to one. Such action on the part of the Opposition is not constructive legislation. There is no necessary antagonism between the colour-makers and the colour-users in this country; their mutual interests are inseparable, and the prosperity of one section is bound up with that of the other.

The same animus against the measure was displayed in a succession of amendments which were ruled out of order. Attempts were next made to restrict the prohibition to dyestuffs manufactured in Germany, but, as the Parliamentary Secretary to the Board of Trade pointed out, to confine the clause to the prohibition of importation from Germany would make the Bill perfectly nugatory. To safeguard the dyestuff industry effectually, it had to be safeguarded against competition from all outside sources. Moreover, there would be nothing to prevent the German dye-makers from establishing depôts in other countries and exporting the dyes thence. A moving appeal was made on behalf of Switzerland, which, it was contended, had continued to help us throughout the war, and, it was added, incidentally to help herself. To what extent Switzerland made herself an agent for the transmission of German-made dyes was not stated.

This character of argument was too much for the patience of some members of the Committee. Sir Philip Magnus, the member for the University of London, bluntly charged members of the Committee with the deliberate intention of obstructing the Bill; from the speeches at the first sitting it was obvious that every possible opposition would be made. This unmasking of their batteries was naturally warmly resented by the militant members, led by Major Barnes, Col. Williams, and Major Hayward, who protested, in the words of Major Wood, that they were "not out against protecting or assisting the dye industry." What they objected to were the means by which that end was to be reached. But whatever affection they might feel towards the dye industry was most effectually dissembled. In the end the attempt to restrict the prohibition to Germany was de-

feated by a majority of nearly three to one. Later attempts to leave out the provision as to colours and colouring matters and organic intermediate products; to direct the Advisory Committee as to the grounds of their decisions; and to provide that "prohibition shall not apply to any such goods manufactured within the British Empire," were either abandoned or were defeated by large majorities on division. A similar fate met amendments raising the question of the date of the application of the Act; the prohibition of synthetic organic products imported mainly for medical purposes; and the importation of new colours.

The longest discussion occurred on the question of the composition and functions of the Advisory Committee which the Board of Trade is empowered to set up for the purpose of advising it with respect to the granting of licences. This Committee is to consist of five persons concerned with the trades using dyestuffs, three persons connected with their manufacture in Great Britain, and three persons constituting "a neutral body"—that is, persons not directly concerned with the manufacture or use of dyestuffs—one at least of whom is to possess "high scientific qualifications"—not, as one Opposition amendment suggested, "a person of medical skill," although why such a person is needed on such a Committee is not very obvious. Various attempts were made either to enlarge the Advisory Committee or to place upon it representatives of particular trades, such as the export branches of the textile industries, the woollen and worsted industry, and the cotton industry. Nor were the claims of Labour, as such, forgotten. But the President of the Board of Trade, who throughout the four days' proceedings had discharged his responsibilities with urbanity and tact, firmly resisted all attempts to tamper with the constitution and functions of the Advisory Committee as defined in the Bill, and in the end, after repeated divisions, in which the malcontents were defeated by increasing majorities, he got his way.

As a last resource, the Opposition sought to curtail the operation of the Act. It is provided that the Act shall continue in force for a period of ten years and no longer. Successive amendments were moved to limit it to one year, then to three, next to seven years; but after the closure had been carried it was decided that the words proposed to be left out should stand part of the clause, and ten years is to be the duration of the Act, which, as afterwards stated by Sir Robert Horne, is to come into force on January 15 next. Major Wood then moved that the Act shall cease to be in force if an Order in Council, on an address by both Houses of Parliament, should so determine; but the amendment was declared to be out of order. An Act of Parliament can be repealed only by an Act of Parliament.

The debate in the House on the Report stage of the Bill was to a large extent a repetition of the proceedings of the Committee. Clauses were moved to limit the extent of prohibition on the import of dyestuffs; to limit dividends and profits by manufacturers of synthetic colouring matters; to curtail the currency of licences; and to alter the constitution of the Advisory Committee; but, after repeated applications of the closure, these several amendments were defeated by even larger proportional majorities than they had met with in the Standing Committee.

On the third reading a last despairing effort was made to reject the Bill, but the appeal to Cæsar met with no success, and the twenty-five stalwarts were beaten by a majority of nearly five to one.

The Meteorology of the Antarctic.

British Antarctic Expedition, 1910–1913. *Meteorology*: Vol. i., *Discussion*. By Dr. G. C. Simpson. Pp. x+326+v plates. Vol. ii., *Weather Maps and Pressure Curves*. By Dr. G. C. Simpson. Pp. 138+23 plates. (Calcutta: Thacker, Spink, and Co., 1919.)

IT was a fortunate day for meteorology when Capt. Scott invited Dr. Simpson to join his last expedition as meteorologist. The Antarctic has always provided a fascinating field on account of the symmetry of its general circulation combined with remarkable local phenomena; but never before has a meteorologist and physicist of the first rank studied Antarctic meteorology on the spot and presented to the world the digested results of observations planned and executed by himself.

The two volumes now published contain a comprehensive discussion of Antarctic meteorology in 1911–13, and a series of weather maps at 8 a.m. and 8 p.m. daily (presumably 180th meridian time) from April 1 (1911?) to January 2 (1912?), a period of nine months. A third volume will include detailed tables of the results of observation. The printing was done in Calcutta and is good, but the registration of the synoptic charts is frequently indifferent.

In a brief preface tribute is fittingly paid to the

people of Derby for the provision of funds for instruments and to the other members of the expedition for indispensable assistance in maintaining the records; the author proceeds modestly to disclaim ability or interest in statistical meteorology; nevertheless, the book abounds in means and averages, frequency curves and Fourier coefficients, correlations and probable errors, and dispels, by its completeness, the suspicion engendered by pp. vi and vii of the preface that the author was approaching his task under the impression that the function of meteorology was to "attempt" the questions of a Saturday morning problem paper rather than to record facts and to set them in order for the information of mankind.

The observations on which the discussion is based were made at the base stations Cape Evans and Cape Adare, at Framheim (Amundsen), and for shorter periods at different places on the Barrier and the plateau by the various parties. Two very instructive maps in the introductory chapter show the surroundings of Cape Evans and Cape Adare, and indicate that the situation of neither station was very good from the meteorological point of view: an indication which is supported by the records of wind. At Cape Evans 43 per cent. of the winds were below ten miles per hour, and the direction of the wind bore so little relation to the general distribution of pressure that on a large number of occasions it appeared to be blowing *out* of the centre of low pressure. At Cape Adare, the northern extremity of a promontory twenty miles long, 72 per cent. of the winds were below five miles per hour, whereas at a well-exposed station in the British Isles only about 10 per cent. of the winds come into this category; and in a similar situation further west in the Antarctic Mawson found an average wind speed for the year of fifty miles per hour.

The main discussion is divided into nine chapters dealing with temperature, wind, cloud and precipitation, pressure and its relation to winds and weather, general circulation, the upper air, the height of the Barrier and the plateau, and atmospheric electricity. Each chapter contains not merely a discussion of the results of the observations and a rational explanation of the facts revealed, but also some new contribution (such as, for example, a study of the gustiness of the wind) which was rendered possible only by the new instruments and methods not previously available in Antarctic work.

The annual and diurnal variations of temperature are shown to be, on the whole, due to insolation, but two features present difficulty. There is a diurnal variation of temperature during the months when the sun is completely below the horizon, and the "day" hours are, on the whole, warmer than the "night" hours. No rational explanation is given of this effect. The suggestion that it arises from scattered radiation from the upper layers of the atmosphere which come into the sunshine during the "day" hours is not mentioned, and it appears to be excluded by the fact that the effect is more marked on cloudy than on clear days, and by the further fact that on clear days there are two maxima at about 4 a.m. and 4 p.m., the time of minimum pressure in the semi-diurnal barometer oscillation. The unusual feature in the annual variation is roughly this: on the Barrier the amplitude of the variation is "oceanic" and the phase "continental," while in the Arctic the amplitude is "continental" and the phase "oceanic." The explanation put forward is, roughly, that the continents of Asia and America control the amplitude in the Arctic Ocean, and the Antarctic Ocean controls the amplitude on the Barrier; the argument is well stated, but it is not entirely convincing.

The records from the Dines pressure tube anemometer, many of which are reproduced, add greatly to the interest of the chapter on wind, and, indeed, to that on temperature, too, by the light they throw on blizzards and other sudden changes. The winds at Cape Evans were found to be about 50 per cent. more gusty than the winds at Scilly and Holyhead; but the gustiness decreased as the speed of the wind increased, indicating, according to Dr. Simpson, that the high value was due, not to the exposure, but to the interaction between a warm upper current and a cold surface layer which are co-existent in the Antarctic more frequently than in England.

Pressure-waves travelling outwards from the centre of the continent are Dr. Simpson's contribution to the explanation of the synoptic charts of the Antarctic. He rejects Lockyer's scheme of travelling cyclones, and pours scorn on the suggestion that the motion of the air in a blizzard is part of a very large cyclonic system. "A depression with its centre in 60° S. able to produce a blizzard of 40–60 miles per hour in 78° S. is of course quite inconceivable. Whatever blizzards may be due to, they are certainly not part of the circulation around a cyclone the centre of which is more than 1000 miles away." He appears here to be doing less than justice to Lockyer's scheme, which may represent the broad features of the pressure distribution, even although all the cyclones do not adhere rigidly to the 60th parallel of latitude.

The theory of pressure-waves will undoubtedly

provoke much discussion; facts are marshalled in an imposing array to support it, and theoretical synoptic charts are produced which are wonderfully similar to the charts based upon actual observations. The pressure-waves are apparently not sound-waves; they are described as "true pressure-waves traversing the upper atmosphere in the same way that water-waves travel across the sea"—*i.e.* they are waves formed at a surface of discontinuity. As the waves appear to be at least 500 miles from crest to trough, there cannot be very many of them—probably, in fact, not more than one—in existence at a time, so that the comparison ought to be with one long wave in shallow water (*e.g.* a tidal wave) rather than with "water-waves travelling across the sea"; it appears doubtful if it is possible at the surfaces of discontinuity, which certainly exist in the Antarctic, to get waves 500 miles long travelling at forty miles per hour, and having pressure amplitudes of 20 millibars at sea-level. The horizontal transference of a large mass of air naturally suggests itself as an alternative explanation, but the adjustment of the motion to the pressure gradient presents difficulties.

In his discussion of the general circulation Dr. Simpson arrives at conclusions agreeing in some respects with Hobbs, and in others with Meinardus. Broadly speaking, he makes the whole continent an anticyclonic area surrounded by a broad band of low pressure about lat. 65; but at 10,000 ft. the plateau alone is anticyclonic, while a very marked cyclone is centred over the part of the Antarctic which is near sea-level. The upper winds deduced from cloud observations and from Erebus's smoke fit in well with the scheme.

The free atmosphere over the Antarctic had never been explored before Dr. Simpson sent up his *ballons-sondes*; the results of this first attempt are remarkably good, although the stratosphere was not reached. Out of twenty-one ascents, fourteen instruments were recovered, of which twelve furnished good records; but three of them referred to different times on one day, November 19, 1911. In six cases of summer ascents the temperature decreased steadily upwards at a rate of about 6° C. per kilometre; in four cases of winter ascents temperature rose at the commencement of the ascent, and began to fall only after a height of one or two kilometres had been reached. The lowest temperature recorded in these ascents was −46° C. (−51° F.) at a height of 6750 m. (22,000 ft.) on Christmas Day, 1911. The lowest temperature recorded on the Barrier was −60° C. (−76° F.) on July 6, and this is the lowest temperature recorded anywhere in the Antarctic.

The observations on atmospheric electricity led to interesting conclusions on the effect of drift-snow, which, however, could not be put to the crucial test owing to Dr. Simpson's unexpected recall to India. One is, indeed, forced to observe that the Government of India was decidedly less than generous throughout. It might well have lent Dr. Simpson's services in such a glorious cause, seeing that a proper knowledge of Antarctic meteorology is vital to an understanding of those great currents of the atmosphere to which monsoons belong; instead, it granted him "leave without pay," and then recalled him in the middle of the enterprise.

The work is a notable contribution, not merely to Antarctic meteorology, but also to meteorological science; it is an enduring monument to the great leader of the expedition through whose foresight and scientific spirit the enterprise was made possible.

Imperial Mineral Resources.

(1) *Imperial Mineral Resources Bureau. The Mineral Industry of the British Empire and Foreign Countries. War Period. Arsenic.* Price 6*d.* net. *Felspar.* Price 6*d.* net. *Chrome Ore and Chromium.* Price 1*s.* net. *Fuller's Earth.* Price 6*d.* net. *Magnesite.* Price 1*s.* 3*d.* net. (London: H.M. Stationery Office.)

(2) *Tungsten Ores.* By R. H. Rastall and W. H. Wilcockson. (Imperial Institute: Monographs on Mineral Resources, with Special Reference to the British Empire.) Pp. ix+81. (London: John Murray, 1920.) Price 3*s.* 6*d.* net.

(1) THE necessity for complete and accurate information about the mineral resources of the British Empire has repeatedly been emphasised in these columns and elsewhere. Even before the war this need had become evident, and it was felt to be a serious reflection upon British statisticians that the most trustworthy source of such information was to be found in an American publication. During the war, the gravity of this deficiency naturally became accentuated, and the formation of the Imperial Mineral Resources Bureau has been the result. This bureau has now been organised, and is entering seriously upon its labours, the result being made public in the form of a succession of pamphlets, each dealing with one particular mineral. Those hitherto issued relate to minerals of relatively minor importance, and include arsenic, felspar, chrome ore and chromium, fuller's earth and magnesite. The

scheme of all these pamphlets is identical; they commence with a general description of the mineral discussed, its composition, uses, and chief sources of supply. The world's output of the mineral is then given, and this is followed by a detailed description of the occurrences in the United Kingdom and the rest of the British Empire, together with statistics of production, followed by similar information concerning foreign producers. References to technical literature on the subject are given in an appendix, and in some cases there is an additional note on some important application of the mineral; for instance, the pamphlet on magnesite contains a note on the production of magnesium chloride and its use in the manufacture of Sorel cement. It should be added that the statistics and information relate in each case to the "war period," 1913–1919. These publications thus form a continuation of those formerly issued by the Home Office, and known as part iv. of the Report of the Chief Inspector of Mines. It would probably have been more convenient for most users of these pamphlets if the statistics had been taken rather further back, and given, say, for the last ten years, and if decennial tables were included in all future annual issues. There is some information as to costs and prices, though not sufficient for those interested in the industries, but no doubt in future years these figures will be given in more detail; it is also stated that in future issues data concerning labour, safety, etc., will be included.

The work of compilation has been well and carefully done, upon the whole; it would be easy to point out small errors and omissions, but these are inevitable in the first issue of a publication of this kind, which involves a vast amount of minute and painstaking research amongst a large number of different sources of information, which are often of very unequal value so far as trustworthiness is concerned. Perhaps the least satisfactory feature is the fact that a number of different standards of weight are employed; it is true that a footnote points out that metric, long and short tons are employed, and the equivalent of each of these is given, but this is not quite enough; it should not be necessary for anyone using these pamphlets to make a calculation before he can compare the statistics that he finds on adjoining pages; probably the best plan is to give in every case the tonnages as reported in the original source of information, and in a parallel column these weights in metric tons, which latter are being largely employed by scientific statisticians.

(2) Simultaneously with the issue of these publications by the Imperial Mineral Resources Bureau, the Imperial Institute has issued another volume of its series of monographs on mineral resources, the present one being on tungsten ores, written by Messrs. R. H. Rastall and W. H. Wilcockson. In its general scheme this pamphlet is identical with those produced by the Imperial Mineral Resources Bureau, and its execution is quite satisfactory, though perhaps the economic aspect of the subject receives even less attention here than in the other series of publications. The question that evidently obtrudes itself, however, is whether there is anything at all gained by this duplication of effort. The issue seems to be unusually simple; the Imperial Mineral Resources Bureau has been organised, and is maintained out of public funds for doing just the very work that the Imperial Institute is taking up. If the bureau does not do its work completely and efficiently, it should be called upon to mend its ways; but if it does do the work entrusted to it satisfactorily, it is surely to the public interest that the Imperial Institute should employ the funds entrusted to it in some more useful manner than in duplicating this work, and it cannot be suggested that there are not plenty of other important Imperial problems needing investigation.

H. LOUIS.

New World Zoology.

Zoölogy: A Text-book for Colleges and Universities. By Prof. T. D. A. Cockerell. (New World Science Series.) Pp. xi + 558. (Yonkers-on-Hudson, New York: World Book Co., 1920.) Price 3 dollars.

TEXT-BOOKS of zoology are legion, and they are by no means all bad. Some of them, indeed, like "Marshall and Hurst," are almost perfect specimens of their kind. Yet we can understand the growth of the list, for every experienced professor of the science has his optimistic moments when he thinks that his particular way of teaching the subject is worthy of presentation to an audience wider than that in his classroom. But the unfortunate fact seems to be that few writers of text-books have managed to fulfil their intention. In many cases the individuality ends with the preface, the whole book sinking to conventional competence on familiar lines.

But this is not true of Prof. Cockerell's "Zoölogy," for it has an individuality. "The biology or zoology for the average individual who has no thought of specializing in the department should not be too morphological, too rich in detailed facts of structure and classification. Experience shows that such minutiæ are not remembered, and do not necessarily leave as a residue any broad and useful conceptions." So the author

has space for many interesting stories, which are crowded out of most books, such as Mendelism, "linkage" and "crossing over," artificial fertilisation, Protozoa and disease, social insects, the pedigree of the elephant, and the zones of life.

Another feature is the insistence on practical utility, not in any tiresomely narrow way, but with a wide horizon. Zoology is for life, not life for zoology. There are big ideas to be understood, which will influence the whole conduct of life. Most of these big ideas are difficult, but "from a psychological and pedagogical standpoint, it is surely an error to suppose that each idea must be luminously clear at the moment of presentation." Prof. Cockerell gives his students plenty to ponder over, for he deals with the living substance, the individual, "nature" and "nurture," alcohol and heredity, variation, selection, disease in relation to human evolution, eugenics, and sociology from a biologist's point of view. The chapters are freshly written, very objective, and their brevity is as psychologically sound as it is unusual. The author does not preach at all, but he suggests the responsibility as well as the happiness of playing the scientific game. He also suggests the wonder of the world. So it is not a common text-book this; it is a new presentation.

A third feature of great value is the introduction of biographical chapters. "We are too apt to receive the gifts of science without asking whence they came. . . . As the pious studied the lives of the saints, so may we pause now and then to learn how scientific heroes have won new territory for the kingdom of science. Thus, if we have anything of generous response within us, we may return to our studies refreshed, resolving that we also, in some measure, will further the good cause." So the book contains sketches of Darwin, Mendel, Linnæus, Fabre, Pasteur, and others. There are numerous illustrations, many of them new and interesting, others a little too familiar. For the general student who is not going to pursue zoology far, this is an admirable text-book; for all it is a good introduction.

The Botany of Iceland.

The Botany of Iceland. Edited by Dr. L. Kolderup Rosenvinge and Dr. Eug. Warming. Vol. ii., part i. By Ernst Østrup and Olaf Galloe. Pp. 248+5 plates. (Copenhagen: J. Frimodt; London: John Wheldon and Co., 1920.)

THE present instalment of the results of work on the botany of Iceland is devoted to the Cryptogamic flora, and contains an account of the fresh-water diatoms by the late Dr. Ernst Østrup, and a description of the lichen flora and lichen vegetation by Dr. Olaf Galloe. The former comprises a systematic list of species based on the examination of 572 samples collected by different botanists in various parts of the island. The list includes a number of new species and varieties which are figured in the five plates. The author also gives a table indicating the general distribution, and the distribution in the different parts of Iceland, of the 468 forms listed. From this table it appears that 95 per cent. of the Icelandic forms also occur in the rest of Europe; Asia and America come next with about 50 per cent.; comparing Iceland with the Arctic regions, the greatest resemblance is with Greenland, with which it has 41 per cent. in common. A classified list is also given of the species found in hot springs from thirteen localities.

Dr. Galloe's account of the lichenology of the island is based mainly on observations made by himself during the summer of 1913, when he investigated fairly thoroughly several of the coast districts, although he had no opportunity of examining the desert interior of the island. The author criticises the methods of systematic lichenologists, who have endeavoured to diagnose species on lines similar to those followed in dealing with flowering plants. This, he maintains, has led to the establishment of a large number of species, many of which would probably be shown by culture experiments to be forms of one and the same species. Unfortunately, this experimental method would be difficult and tedious, and there is little hope of its being successfully carried out. In the meantime it is urged that lichenologists should publish extended descriptions of "one single individual" of each type in order to leave no doubt as to the form which it is intended to describe.

A classified list of the species is given, but the greater part of the work deals with the biological and ecological aspect of the lichen flora. The means of propagation and of dispersal of the Iceland lichens are discussed, and an account is given of the chief biological conditions in which they occur. They are classified under three associations—the bark-lichen, the earth-lichen, and the rock-lichen. The conclusion is drawn that Iceland (like other Arctic countries) is poorer in species according to its area than temperate and subtropical countries, but as regards frequency-number and abundance the Arctic regions and Iceland are probably richer than other regions. No doubt this is chiefly on account of the slight competition to which the lichens are subjected.

Our Bookshelf.

Scientific and Applied Pharmacognosy. By Prof. H. Kraemer. Second edition, thoroughly revised. Pp. xxviii+741. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1920.) Price 33*s.* net.

Of all the American works on pharmacognosy, none is so well known in this country as Prof. Kraemer's, and every pharmacognosist will welcome the appearance of a second edition as affording the author an opportunity, of which he has taken full advantage, of increasing the scope of the work and bringing it up to date. In nearly all the descriptions of the drugs the inner (microscopical) structure is included, and also the characters of the powder; more attention has been devoted to the chemistry, and, in the case of those containing important alkaloids, glucosides, or other definite constituents, these are very fully described and characterised. Many of the numerous illustrations are original, particularly those of the sections and the microscopical characters of the powders, the value of which, it must be confessed, would have been enhanced by a statement of the magnification. Pyro-analysis of drugs, carried out by examining sublimates obtained at comparatively low temperatures, to which a good deal of time has been devoted on the Continent during the last few years, has also received attention, although most pharmacognosists will probably agree that its real value has still to be proved. The section on animal drugs is very interesting, particularly the description of cochineal. In the tables arranged for the identification of a powdered drug, the author still adheres to a primary classification based upon the colour, although this has not found general acceptance.

The work is well printed and freely illustrated; it contains a mass of information, much of which is not otherwise readily accessible; and it should therefore find a place in the library of every pharmacognosist.

The Groundwork of Modern Geography: An Introduction to the Science of Geography. By Dr. A. Wilmore. (Bell's Geographical Series.) Pp. xv+396+xxvii plates. (London: G. Bell and Sons, Ltd., 1920.) Price 6*s.* net.

Among text-books of geography this volume is noteworthy, because it has a fresh outlook and strikes new ground, the author having the courage to depart from many of the time-honoured conventions of school geography. The subject is divided into three parts—structural, climatic, and biological geography—the last rightly including the elements of human geography. Economic considerations are kept well to the fore, which helps to dispel the fallacy of regarding economic geography as a distinct subject.

There is here no medley of scraps of geology and meteorology, but a true geographical treatment of land-forms and climate. The only fault we have to find with the sections on climate and vegetation is that in their brevity they tend to overlook causal relations, and lapse at times into mere descriptions. These chapters might well have been extended by the sacrifice of the chapter on the distribution of animals, a subject that in most of its aspects is not required in the geographical synthesis, since comparatively few wild animals directly influence human activities and migrations. The absence, on the other hand, of any notice of the distribution of disease-bearing insects is a serious omission. Useful bibliographies are given to all chapters, and there are some well-chosen illustrations. R. B.

A Course of Modern Analysis: An Introduction to the General Theory of Infinite Processes and of Analytic Functions; with an Account of the Principal Transcendental Functions. By Prof. E. T. Whittaker and Prof. G. N. Watson. Third edition. Pp. vii+608. (Cambridge: At the University Press, 1920.) Price 40*s.* net.

The first edition of this admirable and well-known treatise was the single-handed work of Prof. Whittaker, and was published in 1902. Into the second edition, which was published thirteen years later and reviewed in Nature for June 8, 1916, the results of Prof. Watson's collaboration entered very largely. The scope of the work was then considerably extended. The present, or third, edition appears at a much shorter interval, and contains fewer changes, chiefly represented by corrections and a fuller apparatus of references. But a valuable chapter on ellipsoidal harmonics is an entirely new feature. This fine work is now far larger and more complete than in its original form, and it is inevitable in present circumstances that the price has been considerably advanced. The only complaint that can be suggested in this connection is that, at the high price, paper of a rather better quality might have been provided.

Medical Electricity: A Practical Handbook for Students and Practitioners. By Dr. H. Lewis Jones. Eighth edition. Revised and edited by Dr. L. W. Bathurst. (Lewis's Practical Series.) Pp. xv+575. (London: H. K. Lewis and Co., Ltd., 1920.) Price 22*s.* 6*d.* net.

The seventh edition of this valuable treatise on medical electricity was reviewed in Nature for June 20, 1918. Since that date the subject has expanded in various directions; the war provided a mass of new material for electro-therapeutists, and in the present edition indications of these advances have been inserted. The effects of Röntgen rays are dealt with in discussing physiological and pathological considerations, but there is no mention of the technical apparatus used in this work, for the reason, as Dr. Bathurst states in his preface, that "Röntgenology" is now a separate department of medical work. A chapter on ultra-violet radiation, and new matter relating to ionisation, diathermy, and the electrical testing of muscles, have been incorporated in the text.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Heredity and Acquired Characters.

ALTHOUGH agreeing entirely with Sir Ray Lankester's and Prof. MacBride's criticisms (NATURE, December 16, pp. 500-1) of Sir Archdall Reid's letter, I venture to add a few words on two points.

First, I will attempt to explain to Sir Archdall Reid why it is held that a head is "more innate and germinal and less acquired and somatic than a scar" (*ibid.*, November 25, p. 405).

It is reasonable to suppose that, at least up to hatching, the nurture of the chicks of all domestic races is the same. The differences between their heads are therefore due, not to nurture, but to nature. Nurture is an essential condition of their development, but, being uniform, it cannot be a cause of diversity.

A scar is the precise opposite of this. Its cause is the blow or other external force inflicting injury, an essential condition being the existence of organic matter incapable of resisting the force and with limited powers of regeneration. This condition is uniform over a large part of the body surface, and can never explain the infinite variety in the appearance and position of scars.

We therefore rightly maintain that everything distinctive of the normal head, everything which we can describe, measure, or figure, is *inherent* or *blastogenic*, although appropriate external conditions are necessary for its development; and that, similarly, every feature by which one scar is distinguished from another is *acquired* or *somatogenic*, although germinal potentialities are necessary for its existence.

One other consideration arises out of Sir Ray Lankester's letter. Although I entirely agree that acquired characters are commonly "departures (either increase or decrease) from the usual or normal size, form, or structure of this or that part," yet—as I pointed out in reply to similar definitions by Sir Francis Galton and Prof. Lloyd Morgan—it is "a mistake to make too much of abnormality, or to import it into a definition. Some of the most marked, and certainly the most easily studied and tested, of acquired characters are the differences between the effects of alternative environments, all of which are normal, upon the individuals of a single species. The green colour of a larva of *Amphidasys betularia*, if fed upon broom, is an acquired character, as is the dark colour it would assume upon oak, etc. I think, therefore, that a more satisfactory definition of, at any rate, a large class of acquired characters may be framed as follows: 'Whenever change in the environment regularly produces appreciable change in an organism, such difference may be called an acquired character'" (Proc. Ent. Soc. Lond., 1904, p. cviii.).

EDWARD B. POULTON.

Oxford, December 19.

Environment and Reproduction.

SEVERAL attempts have been made to show that spawning in the sea and in fresh waters, and also in terrestrial conditions, is regulated by temperature. Many examples could be quoted to demonstrate that the rule is for a species to spawn earlier and to develop more quickly in warm water; that, in other words, the period of spawning is early in tropical seas and conditions, and later to the north and south of the tropical belt, and that the period of growth is increased with lowering of temperature. The factors at work, however, are more deep-seated than they appear to be at first sight. That this is so is at once clear from two correlated considerations: (1) There is a period, sometimes a long period, of ripening with reference to which spawning is the culmination, and during which somatic changes and migratory results are produced; and (2) all the adults do not participate in the ripening and spawning.

In the case of the Protista and the Metazoa which reproduce rapidly, an annual phase may be postulated which closely follows the rise and fall of temperature, but in each generation reproduction follows growth, and does not take place until the growth of the cell or of the soma has reached a certain condition. When the growth is represented by a curve the point of inflection may be said to mark the period when, in the case of the cell, the impulse is conveyed to prepare for division, and in the case of the Metazoon the call arrives to the gonad to develop. Now amongst the Metazoa we get all stages, from the rapid reproduction of such forms to those which reproduce twice a year or once a year, and to those which reach maturity after several years of growth and do not necessarily thereafter spawn annually. In each case we have to observe that the somatic need must be satisfied before maturation is introduced. There are aquatic and terrestrial species which in one situation reproduce once a year, and in warm seasons or in warmer situations reproduce twice a year. But we understand by that statement that the conditions have allowed the early generation to grow

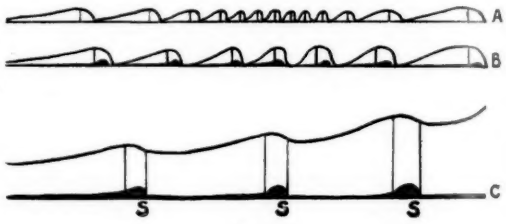


FIG. 1.

sufficiently fast to permit of a second generation in the same season.

In the accompanying diagrams (Fig. 1) an attempt is made to indicate the effect of summer and winter on Protozoa (A) and on Metazoa which have many generations a year (B). Lowering of temperature in these cases would restrict growth, and therefore the number of generations. The diagrams also depict the acceleration and retardation of growth and reproduction of planktonic species passing to and from tropical seas. In (B) the history of the gonad is indicated by the black curves. This is also done in (C), which is meant to show the periodical changes in a species which spawns regularly.

With regard to the last, we must first differentiate between the individual and the crowd. The spawning period may be a long one in the tropics, but it is periodic for the individual, and, indeed, spawning seasons are in many cases sharply indicated in tropical species of all groups. If, with reference to such an example as (C), the season of the commencement of maturation of the gonad be approximately constant, the effect of lowering of temperature would be manifested by a later spawning. Such considerations go, therefore, a long way to explain the observed results, and they also serve to explain the length of the tropical spawning season and the more restricted season of temperate, and especially of Arctic, regions. Without reference to

other environmental factors, it may be granted therefore that growth and reproduction vary in length and periodicity with temperature. Nevertheless, the fact that the spawning season may be postponed makes us feel unsatisfied with an explanation which transfers in a general way, as, say, by the physical condition of the circulation, the function of intimating to the gonad that it can proceed with its development. Besides, the regularity of the spawning seasons, the manner in which summer and winter are impressed upon the most sedentary animals, the influence of warmth and density in promoting larval life, and other similar considerations, bring us back once more to the question of environment.

There may be said to be, as is shown in the accompanying diagrams, three phases of life in all animals: immaturity, maturity, and spawning. If the act of spawning is not followed by death, then there succeeds a series of similar phases. If we are prepared to recognise that the phase of immaturity is not ended alone by the attainment of the requisite somatic growth, then it is regulated by an organ which acts as an inhibitor of the next phase, and continues to act, not merely until the soma is in the requisite condition, but until the environment is also favourable. Such an organ must be placed in a convenient situation for receiving impressions from the environment and for communicating to the blood a hormone the function of which is to inhibit the development of the gonad. In the case of aquatic animals we naturally turn to the gills to see if such an organ is provided, and it is already apparent that the thymus has been developed for this purpose. The thymus is a larval organ which develops in association with the gills, and it is already known that its secretion inhibits the growth of the gonads. A thymus-like secretion will probably be found to be at work in this manner in all animals. In the Craniata the thymus is removed from its primitive position in the gills, but it lies near the gills of fishes, and in them and the higher Craniata continues to exercise its function of controlling the period of adolescence.

When the thymus ceases to supply its secretion to the blood the gonad commences its period of growth, and it is probably then that the thyroid comes into action to control in similar manner the growth of the gonad. The thyroid has an interesting history, and in the higher animals at least its relationship to the gonad has long been known. It is developed in the floor of the gill-chamber, and therefore is in a favourable position not only for helping in the straining of the food by the gills, but also for intimating to the blood the reception of the food, and even other environmental changes. The thyroid, then, probably controls the second phase; and if the thymus, so to speak, during the first is constantly intimating to the gonad that it is not time yet to commence growth, that the environment is not in the right condition, so can we imagine the thyroid controlling the degree of growth until temperature and other conditions are favourable for spawning. Both these ecological organs may be presumed to influence the growth of the soma according to the environmental changes. The gonad itself during its period of growth contributes messages to the blood which influence growth and produce migrations.

With these organs we have to associate the pituitary body, which arises from the ectoderm of the roof of the mouth, and the parathyroids, which are developed in the gills. The former appears to be very like the thyroid in function, and the latter are yet little understood. Until we know more of these organs it would be idle to speculate as to their primitive functions. The actions of such organs of the environment may tend to be automatic, as has been suggested, but it is probable that direct impulses are introduced producing adaptation to changes in salinity and temperature. For example, there are widely distributed species, but restricted to tropical and temperate seas, and others which with little or no modification manage to live in every kind of water from equatorial to Arctic. Many of the species, therefore, which have with great difficulty been differentiated amongst holoplankton will likely turn out to be more physiological than morphological in character.

We have yet a lot to learn from biochemical inquiry and from experiment as to these fascinating ductless glands. I have, in the meantime, tried to show that some of them are concerned in conveying impressions of the environment to the soma and to the germ-cells by a series of impulses carried by the blood, and leading to a primitive but effective internal and external integration. It is probable that reproduction in general in Protozoa, and in the cell as in Metazoa, is so controlled, and that such fundamental effects may have a profound pathological bearing.

ALEXANDER MEEK.

Armstrong College, Newcastle-upon-Tyne,
November 8.

Mode of Feeding and Sex-Phenomena in the Pea-Crab (*Pinnotheres pisum*).

THE pea-crab which lives inside mussels, cockles, and sometimes even oysters, has been an object of general interest since the days of the Pharaohs, and many legends have been invented of the way in which it feeds and of its relation to its host. Calman gives an account ("The Life of Crustacea," by W. T. Calman, London, 1911, p. 217) of many amusing habits attributed to this crab by many writers. For instance, the pea-crab has been stated to warn its host of the approach of enemies or of the entrance of prey between its gaping valves, but it will be seen from what follows that the bivalve and crab depicted in Egyptian hieroglyphics to symbolise the dependence of man on his friends is indeed an appropriate symbol.

A search of modern literature, however, reveals that only vague accounts exist of the manner in which this crab feeds and lives. Recent work on the mode of feeding in bivalve molluscs and other plankton feeders suggested a possible way in which crabs imprisoned in these animals might obtain their food. It will be remembered that in those animals which feed on plankton—floating organisms—by using the gill as a food-sieve, the food-material is collected generally into cylindrical masses by means of mucus, and such is the case in mussels, cockles, oysters, and other bivalves. Thus animals living in the unoccupied space between the valves of these bivalves have ready access to a concentrated supply of food. Now it is easy to watch a pea-crab inside a mussel by cutting a window in the shell of the bivalve and allowing a crab to creep inside it. This has been done, and the bivalve fed on concentrated plankton. It was found that a hungry crab soon begins to feed in the manner described below.

The larger pea-crabs generally sit on the middle of the bivalve, with a pair of the bivalve's gills on each side. The smaller crabs may be found in any position inside a mussel, but are generally somewhere on the gill. When a crab is observed through a window in a mussel-shell it is seen that such a position is taken up generally so as to bring the edge of a gill-leaflet up against the abdomen of the crab. Now as the edge of a gill-leaflet is one of the main food-paths in a bivalve, it will be seen that when the mussel is feeding cylindrical masses of food will automatically pass along the edge of the gill-leaflets, and therefore

along the part of the gill to which the crab has approximated its abdomen and within easy reach of its claws. When feeding the crab moves, or rather scrapes, its claws over the gill, and by means of the hairy nature of its claws easily catches hold of the mucus-strings entangling the food and transfers them to the region of its mouth. The claw is now scraped over the region of the mouth, and the specially hairy mouth-parts of the crab, working in an opposite direction, comb off the strings of food and press them into the mouth. The claw of this crab is apparently specially modified to enable it to be flexed about the middle of its length for giving the unusual scope of action required for the scraping movements.

It is thus seen that the pea-crab is a parasite, and no advantage of its presence to the host has yet been detected, unless it be the occasional association of the palps with the crab, for in this case the crab would be relieving the host of the necessity for transporting and expelling undesirable food; on the other hand, the crab would appear to do no more harm to the mussel than to make it collect food faster or for a longer time than would be necessary in an abundant supply of food if the crab were not there.

There is thus good reason to believe that those allies of the pea-crab which are known to live in plankton-feeding animals—for example, other bivalves and Ascidians—will be found to feed in the same way as this crab.

In the search for these pea-crabs during the summer it was observed that berried females were frequently found alone in a mussel, and that males appeared to be scarce; the method of fertilisation, therefore, was not understood, and appeared to be worth investigating. It is well known that in this crab there is a marked sexual dimorphism, the males being small, very hairy, and, it may be added, very active, while the females are large, relatively smooth, and extremely passive. Moreover, tiny females have apparently never been described. There was thus the additional problem of interest of the whereabouts of the tiny females—if, indeed, tiny females should exist. The whole of the phenomena suggested protandry—a suggestion that was strengthened by my obtaining a tiny female form moulted from a minute supposed male crab with a carapace only 2·7 mm. wide. This tiny female form—now 3·3 mm. in diameter—however, was found to have enormous spermothecæ crammed full of mature spiked sperm and only a trace of gonad, which was, however, obviously female. The moult of this specimen was now carefully examined, and found to possess the full number of abdominal appendages characteristic of the female, although otherwise not recognisable externally from a male.

Many other male-like tiny female specimens have been obtained, and also a series of moults which leave no doubt that the young male-like female attains the adult characters through a succession of moults. It is an interesting fact that all the larger females examined have been found to have their spermothecæ always full of mature sperm. It would therefore appear that this pea-crab copulates precociously at an extremely early age before settling down to its later sedentary life, and, so far as my observations have gone, it would seem that no further meeting with a male is necessary, although males have been found in the autumn inside the same host as large females; a newly moulted female, however, appears to have no charm for a male. Sexual dimorphism in the species is thus seen to be accompanied by dimorphism of the females, and the change from the male-like form of the female to the adolescent young-bearing female form appears undoubtedly to depend upon, and to occur after, copulation. It would also appear that copulation normally takes place inside the host, and that the males visit mussels in their search for females, since unwary male crabs have been found with their legs or bodies trapped by the mussel closing its shell before the crab could get inside. These crabs survive the rough treatment by reason of their extraordinarily strong carapace, and creep inside the mussel later when it must perforce relax and open its shell in order to breathe. The male-like female has a similarly hard carapace which prevents the animal being crushed to death if unluckily trapped by the mussel destined to become a host. Individual crabs have been found to be lacking a leg which might very well have been lost in this dangerous operation.

The life-story of this animal is probably not yet complete, since the tiny male-like female appears to possess a different sexual apparatus from the older forms, and a single male form has been found with a carapace closely resembling that of a female. It is hoped, therefore, to complete the investigations in the near future.

J. H. ORTON.

The Laboratory, Citadel Hill, Plymouth,
November 10.

The Energy of Cyclones.

MY objection to Mr. Deeley's suggestion (NATURE, December 16, p. 502) that cyclones are caused by an access of warmth in the stratosphere is that in that case the troposphere ought to bulge upwards over the cyclone, whereas, in fact, it bulges downwards. The inversion at the boundary renders it certain that the interchange of air between the troposphere and the stratosphere is very slow, and for the few days of the life of a cyclone we may, to get a clear idea, imagine a light but impermeable film to exist at the boundary. If a patch of air above the film were warmed by any means it would expand outwards and reduce the weight on the film, which should, in consequence, rise. If, on the other hand, the film were drawn downwards, the temperature of the air above it would rise, because each air-particle as it lost in height would come under an increased pressure, and be warmed adiabatically. If, then, the air is drawn outwards horizontally from a cyclone in the upper part of the troposphere, the conditions as to temperature and the position of the top of the troposphere that are known to prevail are readily explained.

The point mentioned by Sir Oliver Lodge in his letter in NATURE of November 25 has been, I think, put forward by von Besold and others, but Sir Oliver seems to have overlooked the result of the heat set free by the condensation of the vapour. Could a cubic metre of damp air be confined in an adiabatic but extensible balloon and the vapour be condensed by any means, the result would be an increase of volume, for the expansion due to the heat produced by the condensation would far more than balance the contraction due to loss of pressure. If, indeed, the heat-energy due to the latent heat of vapour all took the form of kinetic energy in the atmosphere, quite a trifling rainfall would suffice to produce over the same area the most violent cyclone ever recorded.

W. H. DINES.

Benson, Wallingford, Berks.

The Mechanics of Solidity.

IN NATURE of November 18 last Mr. J. Innes pointed out that if a number of substances be arranged in order of increasing coefficient of linear expansion, then they are very nearly in a series of decreasing hardness, as shown by Brinell's, Moh's, or Auerbach's test, and he has, therefore, suggested, that it should be possible to obtain a fair

idea of the so-called mechanical properties of substances from an inspection of their more fundamental physical constants.

It seems highly probable that there is some simple relation between the many physical constants of substances, and, indeed, many formulæ connecting them have been put forward, viz.:

(1) Sutherland (*Phil. Mag.*, 1890 and 1891) proposed to find the characteristic frequency of the atoms of elements by the formula

$$\nu \propto \frac{\sqrt{\frac{T_s}{A}}}{\alpha T_s V^{\frac{1}{3}}},$$

where ν is the characteristic frequency of the atoms, T_s the melting point on the Absolute scale, A atomic weight, α mean coefficient of linear expansion between 0° Abs. and T_s° Abs., and V atomic volume $= A/\rho$, where ρ is the density.

(2) Einstein (*Ann. d. Physik*, 1911) has proposed

$$\nu = k\sqrt{\frac{V^{\frac{1}{3}}}{K.A}},$$

where ν, V, and A have the same significance as above, K is the bulk modulus of elasticity of the body, and k a constant which Einstein's theory demands should have the value $2{\cdot}8\times10^{7}$, but for which the empirical value $3{\cdot}3\times10^{7}$ seems to agree much better with observation.

(3) Debye (*Phys. Zeits.*, vol. xviii., p. 276, 1917, and *Ann. d. Physik*, vol. xiv., p. 789, 1912) asserted that ν is the frequency of vibration of those elements in a substance which determine the velocity of sound in it, and he has therefore calculated ν from E, and σ, where E is the Young's modulus of elasticity of the body and σ its Poisson's ratio.

If, now, the ν of Debye and that of Sutherland or Einstein are identical in their physical significance, we may write

$$\frac{\sqrt{\frac{T_s}{A}}}{\alpha T_s V^{\frac{1}{3}}} \propto \nu \propto \sqrt{\frac{V^{\frac{1}{3}}}{K.A}} \propto F(E.\sigma),$$

where $F(E.\sigma)$ is Debye's function for the determination of ν in terms E and σ.

It is of interest to note that Debye's formula does not involve an empirical constant, and that the constant of proportionality in Sutherland's formula is $\sqrt{P}$, where P is Dulong and Petit's constant, *i.e.* the product of the specific heat and atomic weight of the element.

Other formulæ have been put forward by Planck, Lindemann, and Grüneisen, but it is not considered necessary to add them here.

For a discussion of the agreement of these formulæ with experimental results the reader is referred to *Phil. Mag.* for December, 1917, "Atomic Frequency and Atomic Number, Frequency Formulæ and Empirical Constants," by Dr. H. S. Allen.

Perhaps these formulæ are of the type of which Mr. Innes is in quest.

It will be observed that, in the foregoing, reference to the "hardness" value has been omitted; it is now proposed to justify this omission.

The moduli of elasticity, the ultimate strength, and the coefficients of expansion of a substance are, without doubt, the mathematical expression of certain body or bulk properties, and their magnitudes will depend on the state of equilibrium of the molecules within and throughout the body, as well as on those on the surface. On the other hand, the hardness of a substance was defined in *Engineering* for December 12, 1919, as "the resistance of a surface to deformation by mechanical means," and is, therefore, a surface effect and not a bulk effect. If this is admitted, then the hardness number of a surface is probably closely related to its surface energy, and is, perhaps, a measure of a property analogous to the surface-tension property of a liquid. In this connection proposals put forward by Frenkel (*Phil. Mag.*, April, 1917) on "The Surface Electric Double Layer of Solid and Liquid Bodies" are of interest. In that paper it is maintained that every free surface is a parallel plate condenser the outer plate of which is negatively charged, and consists of electrons in the outer half of their orbits about their positive nuclei which form the positive plate. The charge per unit-area of this condenser is calculated from (1) the number of positive nuclei per unit of area of surface, (2) the number of electrons moving in orbits about one nucleus, and (3) the electronic charge.

The distance between the plates is obtained from the mean radius of orbit of the electrons of any one atom. Thus the energy per unit-area of surface can be calculated. Results obtained in this way were shown to be in agreement with the known surface energy and contact potential of the various elements considered.

It seems to the present writer that attempts to obtain formulæ connecting the mechanical constants of elements with their fundamental physical constants must be along this line if the hardness number is the main object of the search. Many difficulties, however, remain to be overcome, for it appears that the plasticity of a substance must have a much greater effect in determining the "Brinell hardness" than it does in determining the "Moh hardness" of any given substance.

V. T. SAUNDERS.

Royal Naval College, Dartmouth,
South Devon, November 29.

Needs of Polish Universities.

I AM travelling in East Galicia, and have only just seen Mr. H. G. Wells's remarks on the needs of scientific workers in Russia (see NATURE of November 11, p. 352). Using Mr. Wells as a text and applying it to Russia's neighbour, I should like to enter a plea for the Polish Universities of Krakow, Lwów (Lemberg), and Warsaw, which stand in the greatest possible need of American, English, and French scientific and technical literature. From the middle of 1914 to 1918 such literature was unobtainable, and since 1918 the rate of exchange—to-day 1500 Polish marks to 1*l.*—has placed it beyond the possibility of purchase by the three impoverished universities. For some months the Friends' Relief Mission has been making an effort at home to arouse practical interest in the problem, and recently we received some volumes of NATURE. These I took to the librarian of Warsaw University, who showed me over the library. The new English books could have been counted on the fingers of the two hands, and in the periodical-room not a single English periodical was being received, and only two in French. Similar conditions obtain in Krakow and Lwów, capitals of West and East Galicia, and two of the most important intellectual centres in reunited Poland.

CUTHBERT E. A. CLAYTON,
Sec. in the Field of the French Poland Unit.

Nadworna, East Galicia, November 24.

WE believe that the Anglo-American University Library for Central Europe exists to supply the need to which Mr. Clayton refers. The address of the secretary is London School of Economics (University of London), Clare Market, W.C.2.—ED. NATURE.

Domestic Fires and Fuels.

THE Air Pollution Board—a sub-committee appointed by the Manchester Corporation in 1915 to study the smoke nuisance—initiated an investigation of the domestic coal fire by Mrs. M. W. Fishenden. In 1917–18 the Department of Scientific and Industrial Research made grants in aid of the work, and now the Fuel Research Board has, with the concurrence of the Manchester Board, published the results,[1] expressing the opinion that "the investigation into the efficiency of the open fire has yielded a collection of carefully ascertained data, from which it is believed that a new departure can be made in dealing with the whole question of the use of smokeless solid fuel in domestic fires."

It is even yet not sufficiently recognised how grave an offender is the domestic coal fire in the production of the smoke nuisance in regard not only to the quantity, but also to the quality of smoke, although this was shown by Prof. J. B. Cohen many years ago. The Manchester Board was doubtless right in basing the work, as the chairman, Mr. E. D. Simon, points out in his introductory summary, on a scientific study of the domestic grate, about which an astonishing lack of precise information was found. If fires could be rendered more efficient, it was argued that a reduction in coal consumption and in the corresponding smoke production would automatically follow. It was hoped at first to draw up a standard of efficiency in fireplaces which might be enforced by local by-laws. This hope, however, proved illusory, as will be shown later. Determinations were first made of the "radiant efficiency" as the most important property of coal fires of different types—*i.e.* the proportion of the heat of combustion of the fuel which was radiated into the room. Here Mrs. Fishenden was able to start with the methods already elaborated for the study of gas fires by a joint committee of the Institution of Gas Engineers and the University of Leeds. It was found possible to adapt the so-called "Leeds test" to the more difficult problem of the solid fuel fire. The figures given are for the total radiation of heat from lighting to dying out, although from the point of view of the users of a fire the heat evolved in the early period and at the end is of little value. This emphasises the fact that solid fuel fires are less satisfactory for intermittent use or for short periods.

The results obtained were unexpected. The grates examined did not differ much in radiant efficiency. Fed with ordinary bituminous house coal from the Yorkshire Haighmoor (not "Haighmore") seam, all gave figures between 20 and 24 per cent. The superior radiant efficiency of the grates of modern construction proved to be a myth. How is this to be reconciled with the common experience that the newer fires appear to give more warmth in the room for less coal? It seems to be due to the constriction of the opening into the flue, which prevents the flow of an excessive quantity of heat-conveying air into the chimney. Strong draughts are avoided, and comfortable conditions in the room can, therefore, be maintained by a smaller consumption of fuel. Moreover, massive iron bars and cheeks with their cooling action are avoided; fireclay is substituted so as to promote the maintenance of a small fire, while the fuel burns more slowly and more completely. The draught below the fire can be restricted, and that in itself puts a great check on the fire.

The advantages are thus real, but not in the direction which is popularly supposed. It was shown that the mere removal of the bars from a grate has only a negligible effect on the radiant efficiency of a fire. Of course, the ventilating effect of the fire is reduced if the opening to the flue is lessened, but this seems generally to be an advantage. Here one looks expectantly, but vainly, for measurements of the ventilating effect of the newer types of grates. Mrs. Fishenden's measurements were made on an old-fashioned grate provided with an adjustable flue damper. With unrestricted draught it was found to move up the chimney as much as 25,000 cub. ft. per hour, although by regulation of the damper this was reduced to one-tenth. Such measurements on the new types of fire would have been specially valuable for the comparison of different systems of domestic heating. In domestic architecture in this country heating and ventilation go together. There seems to be no practical alternative to the chimney flue, simple, cheap in upkeep, and automatic in action, for the ventilation of smaller houses. The recognition of this led to careful measurement of the ventilating action of gas fires by the joint committee of the Institution of Gas Engineers and the University of Leeds, and similar measurements for modern coal grates would be very valuable.

The experiments on different fuels burnt in the same grate are specially interesting. When burning coal, the radiant efficiency was found to be 24 per cent. With anthracite the figure was 27 per cent. With dry gas coke 28·5 per cent. of the heat was radiated, but this advantage over coal was lost if more than 10 per cent. of moisture was present. Two dry cokes produced by low-temperature carbonisation radiated respectively 31 and 34 per cent. of their heat, but here again the presence of moisture was found to have a deleterious effect. Briquettes of coal proved relatively inefficient with only 19 per cent. radiation. The figures point a moral to producers of coke—*i.e.* the desirability of preventing the degradation of an excellent fuel by excessive moisture, although there are technical difficulties in eliminating moisture altogether. The results for low-temperature coke are striking, and "confirm the fact accepted by all smoke-abatement reformers that it is exceedingly desirable that a fuel of this nature

[1] "The Coal Fire. A Research by Mrs. M. W. Fishenden for the Manchester Corporation Air Pollution Board." Fuel Research Board. Special Report No. 3. Pp. 112. (H.M. Stationery Office.) Price 4s. net.

should be put on the market at a reasonable price." The friability of such cokes has proved a grave obstacle, and, if one seeks to avoid it by briquetting, Mrs. Fishenden's results suggest that any superiority in radiating power would be more than wiped out, while the high cost of pitch—the natural binding material—is not helpful. The Fuel Research Board and private workers are busy with the problem.

One cannot help thinking that the real domestic smoke problem is presented, not by the grates of the type studied by Mrs. Fishenden, but by the enormously more numerous and more voracious kitchen ranges used for cooking as well as for heating. Would a smokeless fuel prove serviceable for these? The present report does not deal with the kitchen range.

Mrs. Fishenden has exploded several popular fallacies. Powders have been sold (under promising names) which are alleged to effect marvellous economies in fuel, as vouched for by people whose official descriptions ought to have implied better things. Some of these powders were examined and found to be essentially common salt coloured with iron oxide. No appreciable effect on the radiant efficiency of a fire consuming coal treated with these salts could be detected. To-day, when coal and money are so scarce, a protective publicity might well be given to these tests in the daily Press.

It appears generally from Mrs. Fishenden's work that the wastefulness of the open fire may be lessened by the use of carbonised fuel, and particularly by the cutting down of draught so as to limit the air drawn through the room and into the chimney to the quantity required for ventilation. The use of solid fuel is still cheaper than that of gaseous fuel for fires which have to be in constant use.

Not the least useful part of the report is the appendix, containing a summary of recent bibliography of work on domestic heating appliances. Attention may well be directed to earlier students of the problem—Rumford, Peclet (whose "Traité de Chaleur" still repays perusal), and more recently Dr. Pridgin Teale, of Leeds, who may be regarded as the pioneer of modern grate reform in this country. Peclet, and perhaps Rumford, seemed quite clear about the significance of excessive flue draught and the need for restricted and variable flue openings, and in reading his treatise one can only marvel that the manufacture of crude appliances has continued to the present day. Still, Mrs. Fishenden's work has placed the whole subject on a more substantial foundation of carefully ascertained data, an achievement which should prove valuable in the campaign of smoke abatement and fuel economy, and at a cost which seems to be relatively insignificant. J. W. C.

A Handbook to Roman Pottery.[1]

THE term "terra sigillata," denoting certain well-known classes of Roman pottery, may be unfamiliar to the ordinary reader, but it is gradually coming into use in place of the somewhat misleading "Samian ware" of the nineteenth-century antiquarian. The late Prof. Haverfield, indeed, stoutly upheld the use of the older term; but it is open to decided objections, being purely conventional, unhistorical, and non-descriptive. Such expressions as "Roman red-glazed ware," "Gaulish red ware," etc., may be more accurate, but are not sufficiently definitive. The authors of the work under review have, therefore, followed Continental precedent and adopted this term, which strictly denotes "clay decorated with stamped patterns" (from *sigillum*, a stamp). The ware with which they deal is the pottery produced under the Roman Empire and found in all parts of Western Europe, which is marked by the use of a fine red paste and a lustrous red glaze, and usually ornamented by means of patterns and figures in relief.

It is the first attempt made in this country to produce a handbook to the study of this pottery, which during the last twenty years has made a great advance, owing to the labours of British, French, and German archæologists, and to the more careful attention paid to the results of scientific excavations in this country. We most heartily congratulate the authors on their work, which is distinguished both by exhaustive knowledge and by scientific accuracy.

Their aim has been to arrive at definite conclusions concerning the development of Roman pottery under the Empire by a diligent study of such details of technique, form, decoration, and design as can be of assistance for purposes of dating, and to base on the results of detailed study

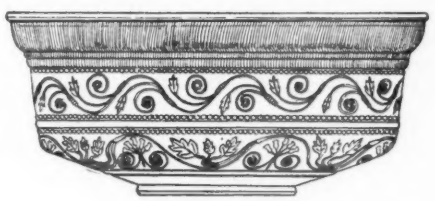


FIG. 1.—Vase of La Graufesenque ware (Form 29) with scroll decoration (about A.D. 40).

a general consideration of the evolution of this pottery and the sources of its inspiration.

The book is divided into ten chapters, the first two being of a general and introductory nature. Chap. iii. deals with "dated sites"—*i.e.* those where the approximate dates of occupation are known, such as Haltern in Germany (11 B.C. to A.D. 9). Chap. iv. gives a list of the potters whose names are stamped on the vessels, arranged in chronological groups. In chap. v. the vessels decorated in moulded relief are discussed under

[1] "An Introduction to the Study of Terra Sigillata: Treated from a Chronological Standpoint." By Felix Oswald and T. Davies Pryce. Pp. xiii+286+lxxxv plates. (London: Longmans, Green, and Co., 1920.) Price 42s. net.

the principal forms of bowls employed. The evolution of the forms and decoration is worked out in a most lucid and interesting manner. The chronological value of this development is further described in chap. vii., and in chap. vi. we have an interesting discussion of the origin of the decorative designs. The figure-subjects are mostly to be traced to the art of the Augustan period, and the decorative motives in many cases to earlier phases of Greek art. It seems a little doubtful,

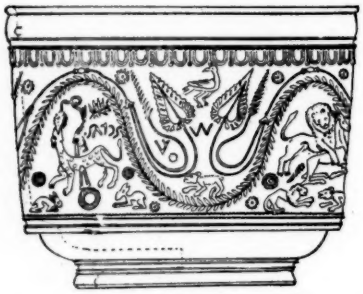


FIG. 2.—Vase of La Graufesenque ware (Form 30) combining scrolls with figure subjects (about A.D. 60).

however, whether motives and methods of decoration which were employed in early Greek art, and disappeared in the sixth century B.C., or even earlier, can have actually influenced the Roman potter. An instance is the "nautilus" ornament found on the Arretine vases and some early Gaulish wares of the first century after Christ. The nautilus certainly occurs in Minoan pottery, but its use was localised, and it is not known in Greek art. It is possible that this pattern is really intended to represent a fern-frond.

Chap. viii. is devoted to a discussion of the plain wares which have only potters' stamps without decoration, and chap. ix. to other methods of decorating *sigillata* ware by painting, incising, or *en barbotine* (patterns produced in relief by thick layers of liquid clay). The final chapter deals with the origin and evolution of *terra sigillata*, and is a general summing up of the whole subject.

There are no fewer than eighty-five excellent plates, all drawn by hand, with adequate biblio-

FIG. 3.—Vase of Lezoux ware (Form 37) with panel decoration (about A.D. 100).

graphical references, and a useful map of sites forming the frontispiece. The general and detailed bibliographies on pp. 245 ff. will also be invaluable to the student of the subject. We should have been glad to discuss this admirable work in much fuller detail, but space forbids, and we can only recommend those who have any interest in the subject to lose no time in becoming acquainted with its contents.

Our illustrations reproduce three typical forms of Gaulish vases with decoration.

Industrial Research Associations.

VII.—The Research Association of British Motor and Allied Manufacturers.

By H. S. Rowell.

No branch of engineering is so much the creature of taste and fashion as the automobile industry. No industry of anything like the same dimensions is so much dependent on the views, almost the caprices, of the layman. Almost certainly no industry in this country has had such a meteoric or rather rocket-like post-war career as that responsible for the manufacture of motor vehicles. These facts must be borne in mind in considering the development of the Research Association of British Motor and Allied Manufacturers.

After the armistice the release of petrol supplies, the diversion of manufacturing agencies from war work, and the natural desire of an overworked public for convenient locomotion and healthy relaxation gave the motor-car trade an unprecedented boom. Motor-car manufacturers were not only confronted with all the distracting problems of reconstruction, but, in addition, they had prospects of—several firms, indeed, had orders for—some years of work. While one or two other research associations were formed as a vital necessity to preserve the existence of the corresponding industries against foreign competition, the motor trade had at the time of the incorporation of this association in May, 1919, no such incentive. At that time to many in the motor industry it must have seemed a luxury, if not an extravagance. Those who have had to do with the inauguration of new societies, especially of societies novel in form or object, know how much work and time are involved in seeking, and often in reconciling or converting, the views of busy men. Even then much preliminary work is necessary before staff can be appointed for the necessary executive work. The Research Association of British Motor and Allied Manufacturers was formed under the ægis of the Association of British Motor Manufacturers, and it is largely to the energy and enthusiasm of

Mr. H. C. B. Underdown, president of the latter body, that the daughter association owes its existence.

The active work of the Research Association of British Motor and Allied Manufacturers began on June 1, 1920, with the appointment of the present writer as technical secretary. Since that time considerable progress has been made in organising committees and arriving at a policy by which to guide future work. A bureau of information has also been established from which are issued classified abstracts of most of the important papers dealing with matters relevant to the automobile. There is in many quarters a rooted and well-founded objection to the collection of information in this way; it is often asked: "Where will it end?" The answer to this question is neither easy nor necessary, but the fact remains that already the information bureau has been of great value. The needs of various industries are different, and the organisation of the research association must fit in with its own particular industry. In the case of one textile industry there was little or no scientific foundation on which to build, and thus the first task of its research association was to gather information. In the motor industry, on the other hand, there is a wealth of information, but it is widely spread and often hard to come at; as one example out of many we have the transmission of heat across a plate between two moving fluids. This problem has been investigated by many engineers in many countries, generally with reference to the steam boiler; the same principles must govern the radiator and heated induction pipe of the motor-car. The abstracts sent out to the members of the association not only keep their technical and design staffs in touch with new developments at home and abroad, but as they are carefully classified they will in course of time provide a basis on which research work may be founded. Moreover, they will become a work of handy reference.

Time teaches, and the views here presented are naturally subject to modification by experience. At present the tasks in front of the association may be set out as follows:—

(1) Collecting, recording, and disseminating to members accurate technical information.

(2) Consultative and advisory work for members of the association.

(3) Original research and investigation into matters of importance to the industry of which knowledge is at present unsatisfactory.

(4) Co-operation with allied industrial and scientific workers.

(5) Examination of new inventions, and, in promising cases, their experimental development.

(6) Impartial tests and verdicts.

A few words of explanation on these brief headings are fitting.

The bureau of information has already been discussed.

Regarding consultative work, it must be clear that a highly trained scientific staff is able to help works engineers and designers in many ways. There are, in any case, two main advantages to be derived from consultative work in a research association quite apart from the immediate solution of any difficulty; not only are the obstacles encountered by one firm brought to the notice of other firms in the association, thus showing them what to avoid, but also the scientific staff is kept in touch with the men in the works, thus learning their needs, their outlook and point of view, and possibly some of the manifold experience which is rarely formulated.

Co-operation with allied trades is especially necessary in motor-car research, for no other product, except perhaps that of the shipbuilder, involves so many handicrafts and sciences as the automobile. As examples, we have spring-making; lamp manufacturing; electrical apparatus for starting, lighting, and ignition; rubber tyres; upholstery; body building; and all the general work implied by mechanical engineering. It would clearly be unjust that the Research Association of British Motor and Allied Manufacturers, an association at present of chassis builders, should, even if it had the necessary resources, embark on such a wide sea of troubles. Thus the title and aims of the association have co-operation in view, and it is pleasant to know that there are now prospects of firms in the allied trades joining the association very shortly. With those allied industries that have already formed research associations close collaboration will be encouraged.

The examination of new inventions may seem to many a piece of unwisdom, since it may be concerned more often with design than with research. On the other hand, it must be admitted that an unbiassed and scientific view is necessary to do justice to the inventor; nor may we forget the epoch-marking innovations which we owe to non-technical people; the textile industry, for example, owes much to a barber and to a clergyman.

The views of men are the product of their experiences, and in the hurry and bustle of practical life notions and prejudices are acquired which time and leisure for reflection would dispel. Or, on the other hand, the natural bias of paternity may lead the designer to retain his devices when better substitutes are available. In such cases a research association can serve a useful purpose in giving an impartial, or at least a different, view. Later, as the organisation develops, it may be that the field of judgment will be extended in order to expose or confirm the various claims of blatant advertisers. In this way the true interests of the public and of the automobile industry will be served.

The objects set out above are probably not the same as those of other research associations, but the needs of various industries are different; it was sound statesmanship that led the Department of Scientific and Industrial Research to give each industry its freedom in the research movement. In considering the list of objects given above, it must not be assumed that the order adopted is

that of relative importance. The great difficulty in securing suitable premises, and the congested and overworked state of university institutions, have temporarily displaced original research from its deserved place of priority. The collecting of information, on the other hand, was at once useful and feasible.

Much emphasis has been given, both in this country and in the U.S.A., to the view that industrial research associations should seek after fundamentals. Quite recently in an important publication appeared the sentence: "It cannot be stated too strongly that the main object of research associations is fundamental research, and that consequently results will usually be slow in coming." With a full sense of the profound respect due to the authors of this statement, the present writer begs leave to disagree. In his view, the main object of industrial research associations is profit, for without profit no industry can live. Disregard by men of science of this vital fact is probably responsible for much of the apathy shown towards science by men in commerce and industry. Here it must be added that the profit point of view is not necessarily a short view; let the vista be as long and as broad as economic conditions warrant, and in cases of doubt let the error lie in distance and in breadth.

The membership of the Research Association of British Motor and Allied Manufacturers represents at present only about one-third of the British motor industry, but it is the object of the council of the association to build up an organisation which shall become a representative national body in the automobile world, and, by working on a practical yet progressive policy, fully adapted to the present temper of the trade, it is hoped to convince not only the entire British motor industry, but also the various allied and accessory trades, of their interest in research. It is clear that the larger the membership becomes, so much the greater are the resources of the association and the benefits of membership. Until the entire British motor industry is included, strict secrecy will be observed in regard to any results of advantage to the trade. At the same time, the interests of research workers (in the pay of the association), to whom credit is an important form of reward, will be assured by publication of their results after members of the association have had, say, three or five years' start of non-members.

There is one difference between pure science and technical science which it is believed has not been emphasised before. When a technical worker is given a problem by industry, the answer or solution is, as a rule, wanted at once, whereas a worker in pure science has, or should have, unlimited time at his disposal. This cardinal difference imposes a totally different solution in the two kinds of work. The technologist may be called upon to eliminate a wasteful process or a dangerous condition. He is not authorised to spend twenty years in finding out a perfect process or in determining exactly what condition is just safe. He is asked to cut out as much waste as possible at once, and, if advisable, to go on improving the process, or in the other case his task is to find out what is safe enough with a reasonable margin for the various probable errors to be expected. The great majority of technical problems cannot be enunciated precisely; only a more simple analogue can, as a rule, be considered. The end in view is an immediate solution sufficiently accurate for the work in hand.

When the technical worker has solved his problem and passed the solution to the designer, he will see, as a rule, unless his scientific curiosity be dwarfed and shrunken, many interesting paths which invite his investigation had he but the needful time and equipment. It is here that he can serve pure science by handing on his boundary problems to the specially gifted men who devote their lives to the development of science as distinct from its applications. How much is handed on in this way and how much retained for investigation by the research association will depend on the ability, vision, and other resources of those concerned; the experience of industrial research organisations in Germany and in America seems to show that the short view does not pay in the long run.

Obituary.

SIR D. E. HUTCHINS.

THE death in New Zealand was announced in the *Morning Post* of December 3 of Sir David Hutchins, the well-known forester, at seventy years of age. Sir David (with eleven contemporaries, including the late Prof. W. R. Fisher, Mr. E. C. Hill, late Inspector-General of Forests in India, and Mr. E. P. Popert, late Forestry Adviser to the Commissioners of Woods and Forests) was appointed a probationer for the Indian forest service in the spring of 1870, and sent to France for instruction in forestry. Shortly afterwards, on the outbreak of the Franco-German War, he returned and studied, with the other probationers, botany and other auxiliary subjects in Scotland under the supervision of the late Dr. Cleghorn, himself a retired distinguished Indian forest officer. After the end of the war in 1871 Sir David returned to France and studied forestry at Nancy until the autumn of 1872. He joined the Indian forest service at the end of that year, and remained in it until the end of 1885. Owing to ill-health, he was then transferred to the forest service of Cape Colony. During the latter part of his service in India Sir David was occupied with the measurement of Casuarina plantations which had been established along the Madras coast. From the statistics thus obtained,

he calculated the "form factors" for the species, this being the first attempt of the kind made in India.

Sir David remained in South Africa about twenty years as Conservator of Forests, Cape Colony. During that time he introduced a variety of exotic species, principally conifers and Eucalypts, to supply the colony with the timber which the indigenous forests could not yield. He also caused similar plantations to be established in the Transvaal and the Orange Free State. These planting operations were on a large scale, so that their area amounts now to 75,000 acres; they have been very successful, especially from a financial point of view. Later, Sir David was transferred to British East Africa as director of forest operations, and in that capacity he published a voluminous report on the forests of that Protectorate. He also visited Cyprus and reported on its forests. He paid visits to the Canaries and other tropical and semi-tropical countries, making a special study of the forest vegetation of the last-mentioned. The knowledge thus acquired enabled him to recommend suitable species for introduction to other countries possessed of a similar climate.

In the year 1914 Sir David proceeded with the British Association to Australia, where he remained for two years studying the forest conditions of that country. At the end of that time the Government of Western Australia published for him, in 1916, a full report on Australian forestry and his suggestions as regards future action to be taken by the Governments of these colonies. The report attracted great attention, and Sir Ronald Munro-Ferguson, at that time Governor-General of Australia, expressed the opinion that "nobody has ever written on Australian forestry as Sir David Hutchins has done."

From Australia Sir David proceeded to New Zealand, where he examined the forests, paying special attention to the "Kauri" pine (*Agathis australis*). He urged that the small remnants of that queen of pines should be protected and enlarged. It appears that he died while passing a report on the New Zealand forests through the press. Sir David Hutchins was an enthusiastic forester, who had amassed a vast amount of knowledge on forestry subjects, and especially on semi-tropical forest vegetation. In spite of his enthusiasm carrying him sometimes too far, he did most substantial service to the Empire, and his friends were pleased to see his merits appreciated by the bestowal of a knighthood some months before his unexpected death.

SIR CHARLES BRUCE, G.C.M.G.

BY the death, at the age of eighty-four, of Sir Charles Bruce the country has lost a great scholar and an efficient administrator. The son of an Indian Civil Servant, in his early years Sir Charles devoted himself, mainly in Germany, to philological study, chiefly in Sanskrit and Zend-Pahlavi, and he did valuable work in connection with the great Sanskrit dictionary published by the Academy of St. Petersburg. He was next appointed rector of the Royal College at St. Louis, Mauritius, whence he was transferred as Director of Public Instruction to Ceylon. He returned to Mauritius as Colonial Secretary, and was later appointed Lieutenant-Governor of British Guiana. In recognition of his services he received the knighthood of the Order of St. Michael and St. George. In 1897 Sir Charles returned to Mauritius as Governor, where, with the hearty support of Mr. Joseph Chamberlain, then Colonial Secretary, he carried out important reforms in the public services, and as an administrator gained much popularity among the people of the island, until his retirement from the public service in 1903. During his colonial service of more than thirty-five years he gave much attention to ameliorating the condition of the Indian immigrants to our Crown Colonies, a task to which he devoted himself after his retirement. In 1910 he published an important work, "The Broad Stone of Empire," dealing with the problems of Crown Colony administration in the light of his wide and varied experience. Sir Charles Bruce will be regretted by many friends as a man of devout spirit and of singular independence and honesty of purpose, with much charm of manner and kindliness of heart.

Notes.

HIS HIGHNESS THE PRINCE OF MONACO has issued invitations to representative scientific workers of all countries to be present at the formal opening of the Institut de Paléontologie Humaine at 1 rue René Panhard, Paris, to-day, December 23. The President of the French Republic (M. Millerand) has promised to attend. The institute owes its origin to the munificent benefactions of the Prince, whose interest in archæological problems made possible the systematic exploration of the Mentone caves. Its work is most widely known to archæologists through the magnificent series of publications covering the exploration of Palæolithic caves, notably those of Grimaldi, Altamira, and La Pileta. Of the excavations described in these publications some have been undertaken under the auspices and at the expense of the institute. This is especially the case with those of more recent years, such as the exploration of the cave of La Pileta (Malaga), undertaken by MM. Breuil, Obermaier, and Verner. Although it did not undertake the actual exploration of the Altamira cave at Santander, carried out by Dr. Cartailhac and the Abbé Breuil, it was responsible for the publication of the results. It was through the institute and the generous assistance given by the Prince that it was possible for the authors to describe the site and its culture on a scale and with a

wealth of illustration which have made the remarkable series of examples of prehistoric art familiar to archæologists who are not fortunate enough to be able to visit the cave in person.

MUCH interest has been aroused by the registration on December 16 of one of the greatest earthquakes of recent years, and the interest has been increased by the mystery which at present attends the position of its origin. The first preliminary tremors reached West Bromwich at 12h. 17m. 14s. p.m.; the second tremors arrived nine minutes later, indicating an epicentral distance of about 68° of arc. The oscillations at this station were so violent that Mr. J. J. Shaw's seismograph was thrown out of action. The epicentral distance from Oxford was estimated at 67°. From the American records it would seem that the distance from Washington was about 43°. Various positions have been suggested for the origin—China, beneath the Pacific Ocean to the north of Japan, the Atlantic between Sierra Leone and Brazil, or the South Pacific. Prof. H. H. Turner, writing in the *Times* of December 21, suggested that the place of origin was in the Gulf of Mexico, but since then he has seen evidence which indicates an Alaskan origin for the earthquake. No seismic sea-waves have been reported from any place, and this absence seems to favour an origin that is, at least in part, terrestrial. On the other hand, an earthquake so violent must have been felt to a distance of some hundreds of miles from its origin; and thus, if the origin were terrestrial, it must either be in a country from which outgoing messages have been censored or one with few observers or inadequate means of communication—such, for instance, as Yakutat Bay, in Alaska, which is, however, only about 64° from the British stations.

THE announcement that the King has approved of the appointment of Prof. J. C. Irvine as Principal of the University of St. Andrews has been received with feelings of much satisfaction by men of science throughout the country. This is not the first occasion when the chief administrative office in the oldest University of Scotland has been filled by a man of scientific eminence, for Sir David Brewster occupied the Principalship of the United College from 1838 to 1859, and his successor was J. D. Forbes. After a period of years, during which the University was guided by those men of distinction in the world of letters, John Campbell Shairp, Sir James Donaldson, and Sir John Herkless, it now falls to the lot of a chemist to direct the policy of the University of the grey city by the northern sea. The new Principal was a pupil of Prof. G. G. Henderson in Glasgow Technical College before going to St. Andrews as an undergraduate. He afterwards spent a couple of years in Leipzig, where he came under the inspiration of Wislicenus, returning in 1901 to his *alma mater*. On the retirement of Prof. Purdie in 1909 the chair of chemistry in the United College was filled by his assistant. During the past twenty years Prof. Irvine has devoted himself to research on the chemistry of carbohydrates, in which branch he may now be regarded as the leading living authority. He has been particularly successful in imparting much of his enthusiasm to his students; many of the men associated with him in his publications in the Journal of the Chemical Society are graduates in arts who, with no scientific predilections, were attracted to the study of chemistry by the personality of the professor. Principal Irvine's scientific work was recognised by his election as F.R.S. in 1918, whilst his valuable war services earned for him his C.B.E. in the present year. His many friends in academic circles both in St. Andrews and in Dundee have full confidence that in his hands the best interests of their University are in safe keeping.

THE recent reports relative to a fall of rock involving the summit of Mont Blanc, however improbable they might appear to those who have knowledge of the ground, have naturally aroused general attention. The *Daily Mail* of November 27 published a communication from Geneva correcting the idea that the summit had suffered change, but recording the fall of the face of a rock-precipice on to the Brenva glacier, and the sweeping of an ice-avalanche from this glacier through the woods of "Portud" (La Pertu). The *Journal des Débats* for November 29 quotes information given by M. Vallot, director of the Mont Blanc Observatory, to the *Eclaireur de Nice*. M. Vallot points out that the summit is composed of an ice-mass of variable level, and that the source of the avalanche could not have been determined from the Italian side. Presumably this refers to dwellers in the Val di Veni. M. A. Lacroix, permanent secretary of the Paris Academy of Sciences, very kindly informs us that accurate details are not yet to hand, and that the matter may resolve itself into an avalanche of ice rather than a fall of rock.

A SMALL expedition is being organised in the University of Oxford to visit Spitsbergen next summer with the view of conducting researches in ornithology, botany, and palæontology. Work will be confined mainly to the west coast, but if ice conditions permit the northern and north-eastern shores of the mainland will be visited and an attempt made to cross New Friesland and to ascend some of the unscaled peaks in that part of the country. It is proposed to charter two or three sealing sloops in Norway to accommodate the expedition. The first sloop would arrive in Spitsbergen early in June, making for the bird rookeries on the north and west coasts of Prince Charles Foreland; the others would arrive later for work on the north coast. The explanatory side of the expedition's programme depends largely on weather conditions, but the other researches can certainly be carried out. The staff of the expedition has been selected, and will, we understand, include the Rev. F. C. R. Jourdain, who is chairman of the organising committee. Expert advice is being taken in the preparation of the plans and in the selection of the equipment. The *Times* understands that the cost of the expedition is estimated at about 3000*l.*, towards which several generous contributions have already been promised. The expedition has the official sanction and support of the University of Oxford.

THE Forestry Commission was established in order to secure an adequate supply of home-grown timber,

and many people imagine that this can be effected by State afforestation alone. The 1,770,000 acres which the Government has decided to acquire and plant with trees during the next eighty years are quite inadequate. Much of the planting must therefore be done by private owners, who control about 3,000,000 acres of woodlands. Owing to the war and other causes, the great bulk of mature timber on these estates has disappeared, and in all probability only 750,000 acres are fully stocked with trees more than twenty years old. Certainly a great part of the conifer woods has been either clean-felled or thinned to such an extent as to be no longer productive. The remedy is the encouragement of replanting by private owners, who are now deterred by high wages, the enhanced cost of plants, etc. The Forestry Commissioners are prepared to assist private owners in two ways: either by entering with them into partnership in profit-sharing schemes or by giving grants in aid of planting and of establishing a crop under approved conditions. These grants are fixed at 2*l*. per acre for conifers and 4*l*. per acre for broad-leaved trees, and are repayable whenever an owner makes ultimately a profit exceeding 4 per cent. As the new planting season is in full swing, applications for grants should be addressed direct to the Assistant Commissioner concerned: For England and Wales—30 Belgrave Square, London, S.W.1; for Scotland—25 Drumsheugh Gardens, Edinburgh; and for Ireland—6 Hume Street, Dublin.

THE annual exhibition arranged by the Physical Society and the Optical Society is to be held on Wednesday and Thursday, January 5 and 6, at the Imperial College of Science, South Kensington, and will be open both in the afternoon (from 3 to 6 p.m.) and in the evening (from 7 to 10 p.m.). Sir W. H. Bragg will give a discourse on "Sounds in Nature" at 4 p.m. on January 5. Dr. Archibald Barr will lecture on "The Optophone: An Instrument which Enables the Totally Blind to Read Ordinary Print" at 8 p.m. on January 5 and at 4 p.m. on January 6. After the lecture a demonstration will be given by a totally blind person. At 8 p.m. on January 6 Prof. C. R. Darling will give a discourse on "Some Unusual Surface-Tension Phenomena." All the lectures will be illustrated by experiments. About fifty firms will be exhibiting, and a number of experimental demonstrations have been arranged. We understand that invitations have been given to the Institution of Electrical Engineers, the Institution of Mechanical Engineers, the Chemical Society, the Faraday Society, the Wireless Society of London, and the Röntgen Society. Admission in all cases will be by ticket only, and therefore members of the societies just mentioned desiring to attend the exhibition should apply to the secretary of the society to which they belong. Others interested should apply direct to Mr. F. E. Smith, hon. secretary of the Physical Society, National Physical Laboratory, Teddington, S.W.

THE Imperial Bureau of Mycology is the outcome of a proposal unanimously adopted by the Imperial War Conference in 1918 that a central organisation should be established for the encouragement and co-ordination of work throughout the Empire on the diseases of plants caused by fungi in relation to agriculture. The committee of management consists of some of the foremost biologists in the country, with Viscount Harcourt as their chairman, and includes the following members:—Prof. I. Bayley Balfour, Dr. W. Bateson, Prof. V. H. Blackman, Prof. F. O. Bower, Mr. R. D. Cotton, Prof. H. H. Dixon, Prof. J. B. Farmer, Capt. A. W. Hill, Prof. W. H. Lang, Sir Daniel Morris, Mr. J. Murray, Mr. G. H. Pethybridge, Sir David Prain, Dr. A. B. Rendle, Mr. H. N. Ridley, Prof. R. A. Robertson, Sir A. E. Shipley, Prof. W. Somerville, and Dr. H. W. T. Wager. Dr. E. J. Butler, late Imperial Mycologist, Director of the Research Institute, Pusa, and Agricultural Adviser to the Government of India, has been appointed Director, and has started work at the headquarters of the Bureau, 17–19 Kew Green, Kew (telephone Richmond 603). The Bureau will work broadly on the lines of the existing Imperial Bureau of Entomology at South Kensington, and will aim at doing for the other great class of destructive agencies in agriculture, namely, the diseases and blights of plants caused by fungi, what the older Bureau has so successfully done in regard to injurious insects. It will be a central agency for the accumulation and distribution of information and for the identification of specimens sent in from all parts of the Empire.

DR. R. H. PICKARD, principal of Battersea Polytechnic, has been appointed director of research to the British Leather Manufacturers' Research Association.

IN the November issue of *Man* Miss M. E. Durham supplements Dr. W. Crooke's article (Journal of the Royal Anthropological Institute, vol. xlix.) on nudity in India by some notes of similar practices in North Albania. When a new house is built and ready for habitation, the hearth has to be kindled for the first time ceremonially. The fire is laid and the master of the house strips stark naked, enters the house, and ignites the fire by firing a pistol into it, after which the family takes possession of the house. When a new pair of oxen are yoked together for the first time the owner must be nude when he ploughs the first furrow. Miss Durham also notices that there is no feeling against nudity in the case of men crossing rivers by the aid of inflated sheepskins or of those in charge of ferries. The above two cases, which she regards as probably the only cases of ritual nudity in Europe, if, indeed, they are still practised in a region devastated by war, are deserving of record.

MR. C. G. E. BUNT discusses in *Ancient Egypt* (1920, part iv.) the genesis of Coptic twists and plaits, with the result that he traces them to Sumerian origin. Prof. Flinders Petrie sums up the question thus: "These conclusions on the Sumerian being the earliest forms of the twists and plaits accords with other facts of their distribution. The formula which seems to agree with all the cases is that the twist and plait is a Central Asian motive (see the wickerwork screens in Kirghiz tents); that from there it passed down the Euphrates, also into Syria, and first into Egypt under Hyksos influence. Plaits and twists were unknown in Italy until the Dacian captives were brought in and set to mosaic work; plaits were

brought from the north into the basketwork capitals of Justinian, and the round plait in architecture only occurs in true Gothic work in Italy, the Lombard plait being angular, rushwork and not osiers. In Ireland the spiral is alone in the pagan age, and the plait only comes in after the Norse influences of the Christian period."

AN interesting programme was presented at the meeting of the Association of Economic Biologists held in the Imperial College of Science on Friday, December 10. Sir David Prain occupied the chair, and the first portion of the meeting was devoted to the exhibition of specimens. Dr. B. M. Bristol, of Rothamsted, showed a number of very beautiful pure cultures of algæ on solid media, obtained from the soil of the famous Broadbalk wheat-field, the algal flora of which she is studying. Dr. S. G. Paine exhibited bacteria with flagella stained by a new method, and also a convenient new pattern of incandescent lamp which he has devised for microscopic work. Mrs. Alcock showed specimens of Douglas fir attacked by *Phomopsis pithya*, Lind., a parasitic fungus new to this country; and Mr. W. B. Brierley exhibited a fine photograph of Dr. Erwin F. Smith, the eminent American pathologist. Mr. W. J. Dowson then read his paper on "Problems of Economic Biology in British East Africa," dealing especially with the relations of plant disease to climatic conditions. A second paper was read by Dr. M. C. Rayner on "Nitrogen Fixation in the Ericaceæ," in which a convincing case was stated for the fixation of nitrogen by the mycorrhizal fungus in this genus of plants. The papers were discussed by Dr. E. J. Butler, Mr. F. T. Brooks, Prof. V. H. Blackman, and Dame Helen Gwynne-Vaughan.

IN Bulletin 313 of the Agricultural Experiment Station of the University of Wisconsin Prof. L. J. Cole and Miss Sarah Jones discuss the occurrence of red calves in black breeds of cattle such as Aberdeen-Angus, Galloway, and Holstein-Friesian. They point out that red is recessive to black, and was introduced by crosses in the early days of formation of the breeds, when little selection for colour was practised. The more rigid selection for colour at present in vogue has not yet succeeded in eliminating the recessive factor for red from the germ-plasm. Such a simple account of the cause of the persistent sporadic reappearance of red is valuable for practical breeders who have no knowledge of the scientific principles of heredity. It serves to eradicate many erroneous ideas as to the nature of these occurrences.

IT was ascertained by Blacklock and Carter at the Liverpool School of Tropical Medicine in 1919 that the indigenous British mosquito, *Anopheles plumbeus*, could be infected with the malarial parasite *Plasmodium vivax*. As a consequence of this discovery the Mosquito Investigation Committee of the South-Eastern Union of Scientific Societies was asked by the Ministry of Health to aid in discovering the exact distribution of this mosquito in England and Wales. In its Circular No. 4 this committee explains the effort it is making to conduct an inquiry into the distribution of *A. plumbeus* within the areas to which the activities of its affiliated societies extend. The circular gives detailed descriptions of the egg, larva, and fly of *A. plumbeus* and of its breeding-places, illustrated by plates of figures reproduced from Lang's "Handbook of British Mosquitoes," issued by the British Museum, and from Blacklock and Carter's paper in the *Annals of Tropical Medicine and Parasitology*. These, with further information concerning habits, distribution, collection, etc., should make the circular useful to the amateur and efficient for its purpose. It is clear that the Ministry of Health has a keen ally in this committee of the South-Eastern Union of Scientific Societies.

THE October issue of the Tropical Diseases Bulletin, published by the Tropical Diseases Bureau, consists of a Sanitation Number, and comprises extracts from and notes on papers appearing in various scientific journals and official reports. The matter is divided under several heads, namely: Disease Prevention (chiefly Malaria), Conservancy, Water, Milk, Smallpox Vaccination, Rat Destruction, Disinfection, Vital Statistics, and Book Reviews. Most of the notes and extracts are very brief, but appear to bring out the more salient points of the original papers, and will undoubtedly serve as a very useful guide to the student of this particular subject. The paper to which most space is given is one by Sir Alexander Houston on water and sewage purification, reprinted from the Reports of the Progress of Applied Chemistry. This paper, dealing chiefly with water and sewage problems in this country, has, perhaps, only an indirect bearing on tropical hygiene, but it is, nevertheless, highly important from that point of view in that it deals largely with questions of chlorination of water and with algal infection. An interesting point is that the author states that he has recently discovered a means of preventing or removing the residual or, as he describes it, "iodoform" taste in chlorinated water by means of a small dose of potassium permanganate (2 lb. to 8 lb. per 1,000,000 gallons). This question of taste has always been one of the difficulties in the way of the successful chlorination of water and the cause of many complaints from consumers, and Houston's taste-eliminating process should prove an immense boon where chlorination of water is necessary. How much more pleasant it would have been to the troops during the war if this discovery had been made half a dozen years ago!

THE Geological Survey has just issued another portion of the Memoirs on the Economic Geology of the Central Coalfield of Scotland, the present volume dealing with the fourth area into which the coalfield has been divided; this includes an area of rather more than 40 square miles, extending 10 miles to the west of Glasgow, both north and south of the Clyde. The district is not of any great economic interest; the ironstones are, for the most part, thin, and practically all the workable portions have been exhausted. Most of the coal-seams, too, are thin, and the quality is in many cases inferior. There are, however, two features of high geological interest, namely,

the great local thickening of one of the coals, known as the "Quarrelton thick coal," described as "certainly the thickest single accumulation of coal-matter in Britain," and the remarkable crush-zone known as the "Paisley Ruck." Both these are fully and exhaustively discussed in the memoir.

SOUTHPORT Meteorological Observations for 1919 have recently been published by the County Borough, the report being prepared by Mr. Joseph Baxendell. Hourly whole-year normals of several elements for periods ranging from ten to twenty years are given in diagram form as a frontispiece. The tabular statistics of air-pressure, temperature, sunshine, rainfall, wind direction and velocity, with other subsidiary matters, are given for several hours for each month and for the year with the differences from the normal. An outstanding feature of 1919 was the remarkable prevalence of winds from the north-westward, their duration surpassing that of winds from any other direction, which is quite unprecedented since the commencement of autographic records in 1898. The March of 1919 was the wettest experienced during the forty-eight years' existence of the observatory, and this was followed by a deficient rainfall for eight consecutive months. Atmospheric pollution is regularly measured at two different spots in Southport, and an attempt is made to compare the results with those from other places, but the observations to hand are by no means numerous. The recorded meteorological observations are of the highest order, and the report from year to year contains usually some special discussion—a feature in advance of the returns from most corporations. In the report for 1919 the special discussion is the diurnal variation of air-pressure from the averages of ten years, and associated with this is the range of the diurnal sea-breezes. Ten years are too few for such a discussion, and certain elements of irregularity cannot be eliminated in so short a period.

THE *Résumé* of the communications made to the French Physical Society on November 19 contains a short description of the spectrograph for ultra-violet work constructed by MM. J. Duclaux and P. Jeantet. The lenses of the collimator and camera are of quartz and the prism is of water between quartz plates. The whole is enclosed in a wooden box which is sufficiently gas-tight to allow non-absorbing gases to be substituted for air. With a water prism of 70° it is possible to photograph spectral lines from 6000 to 1850 tenth-metres. For light of wave-length less than 2000 water is more transparent than quartz, and throughout the whole of the ultra-violet the dispersion of water is greater than that of quartz. With a condenser spark the line 1862 may be photographed on a Schumann plate which is almost devoid of gelatine in 5 seconds. The only inconvenience of the water-prism for this work is the considerable change of the refractive index with temperature.

THE discovery of the nickel-steels of the invar type, possessing a very small coefficient of expansion, has had many valuable applications in metrology, but careful study has proved the existence of residues, temporary or permanent, much resembling the anomalies in the expansion of glass. The cause of this instability has now been proved by M. Ch. Ed. Guillaume (*Comptes rendus*, November 29) to be the carbon in the alloy. The index of instability is arbitrarily defined as the elongation, in microns per metre, of a bar submitted to a heating for 100 hours at 100° C., the only previous treatment being the air-cooling after forging. For an invar of average composition in the natural state this index has been found to be of the order of 30. The examination of a series of bars with gradually increasing and exactly determined percentages of carbon showed that the index of instability was a regular function of the carbon content, and approached the origin of the co-ordinates as the carbon approached zero. Cementite was regarded as the probable cause, and hence the addition of a metal having a higher affinity for carbon, such as chromium, tungsten, or vanadium, suggested a probable solution of the problem of removing, or at least of reducing, the cementite. Experiments made in this direction have proved successful, the addition of chromium, for example, to an invar containing 0·1 per cent. of carbon producing an alloy in which the index of instability is reduced to one-tenth of its original value. As the price of the increase in stability, the coefficient of expansion is slightly raised.

THE meeting of the Illuminating Engineering Society on December 14 was devoted to the presentation of reports on progress and to exhibits illustrating novelties in lighting. The number of committees working under the society has been increased, recent additions being committees to deal with progress in gas lamps and lighting appliances and with the measurement of light and illumination. Progress in the latter field was illustrated at the meeting by the exhibition of a new form of illumination-photometer enabling illumination to be determined by the inspection of a series of apertures of graded brightness without any manipulation being needed to secure a reading. Such instruments seem likely to be specially useful for demonstration purposes. Other features of interest among the exhibits included a demonstration of the latest form of Sheringham "artificial daylight" apparatus, which is now being made in a standardised form, and some small electrical gas-filled lamps with opal glass bulbs, shown by the Edison and Swan Electric Co. This firm also loaned for exhibition some new neon lamps of a very interesting character. Formerly such lamps, the light of which depends upon an electrical discharge through rarefied neon gas, required a relatively high voltage. But the lamps exhibited resembled an ordinary glow lamp in appearance, and could be inserted in an ordinary lamp-socket on 220 volts. The lamp exhibited was stated to consume only 5 watts, but the light consists of a relatively feeble orange glow at the negative electrode. It is thought, however, that such lamps will be useful as pilot lamps, etc., and in cases where only a very low candle-power is needed. At the conclusion of the meeting the chairman (Dr. A. H. Levy) announced that Mr. J. Herbert Parsons had accepted the presidency of the society in succession to Mr. A. P. Trotter.

THE results of recent investigations on the theory of development by Mr. A. H. Nietz, of which Dr. Mees, of the Kodak Research Laboratory, recently gave an account at the Royal Photographic Society, are given in the current (December) issue of the society's Journal. It is found that the "reduction potential" of a developer can be measured by finding the concentration of bromide required to give the same rate of change of depression of density, and this is the method for its estimation that is least subject to error. The relative reduction potentials of sixteen developing agents are given, beginning with ferrous oxalate as 0·3 and ending with diamidophenol as 30 to 40. The author says that it appears to be well founded that (1) the maximum density tends to increase with increasing reduction potential; (2) no definite relationship can be shown between the time of appearance and the reduction potential, nor is the velocity constant affected by the potential in any regular manner; (3) while the speeds of emulsions vary with the developer employed, they are apparently no function of the reduction potential; and (4) the fogging power of a developer also appears to have no relation to the reduction potential. The author also draws conclusions as to the effect of the structure of the molecule of the developer on its reduction potential. The amino-phenols are the most energetic, the hydroxy-phenols come next, and the amines follow. The introduction of a methyl group into the nucleus or into an amino-group raises the energy, but two methyl groups are not always more effective than one; nuclear substitution of a halogen in the hydroxy-phenols raises the energy, and other less general statements are deduced. The growth of the image and of the fog do not generally follow the same law; evidence was found that fog is practically absent from the high densities and increases as the image density decreases, but bromide restrains the fog more than it restrains the image. Other allied subjects are considered.

MESSRS. J. WHELDON AND CO., 38 Great Queen Street, W.C.2, have just issued a noteworthy catalogue (New Series, No. 91) of books in the various branches of zoological science. It refers to upwards of 2000 volumes, classified under the subjects of Protozoa and micro-zoology, Cœlenterata, Echinodermata, Annelida, Crustacea, Insecta and Arachnida, Mollusca and Polyzoa, parasitology, evolution, heredity, and hybridity. In addition, there is a list of sets and long runs of scientific periodicals which Messrs. Wheldon offer for sale.

A NEW edition of "The Resources of the Sea," by Prof. W. C. McIntosh, is announced for publication by the Cambridge University Press early in January. The work has been carefully revised and brought up to date. A chapter on the labours of the International Fisheries Council is promised.

Our Astronomical Column.

A NEW COMET.—Mr. Skjellerup, of Cape Town, has discovered a new comet 1920*b*; its position on December 13 at 12h. 57·4m. G.M.T. was R.A. 8h. 55m. 16·07s., S. decl. 9° 1′ 48″; daily motion + 4m., N. 1° 19′. The comet is moving towards Regulus, and coming into a favourable position for northern observers. Its magnitude at discovery was 10½. It will be remembered that Mr. Skjellerup discovered another comet a year ago; it was, however, unfavourably placed, and very few observations were secured.

Mr. Van Biesbroeck observed this comet at Yerkes Observatory on December 17d. 20h. 19·8m. G.M.T., R.A. 9h. 16m. 59·6s., S. decl. 3° 10′ 7″. The average daily motion from December 13 to 17 is +5m. 3s., N. 1° 22′. The comet is evidently not very distant from the earth; its motion is direct, and it will pass the ascending node in about ten days. It is visible in a small telescope.

TABLES DU MOUVEMENT KÉPLÉRIEN.—Ever since the enunciation of Kepler's laws efforts have been made to simplify the determination of true anomaly and radius vector in terms of the time. Many of the methods given are ingenious and useful, but none appear to give so rapid a solution as extended tables. Dr. M. F. Boquet, astronomer of the Paris Observatory, has just published a very useful volume with the aid of a grant from the Académie des Sciences; it gives for values of e ascending by intervals of 0·01 from 0·00 to 0·50, and for values of v ascending by intervals of 1° from 0° to 180°, the values of M and $\log r/a$ to three and five decimal places respectively, together with columns of differences for the variation of v and e. It is thus quite a short computation to find v and $\log r$ for a given value of M to 4″ and to the fifth decimal place respectively. Examples are also given showing how the difference-columns may be utilised to obtain seven-figure accuracy by a straightforward computation. These tables will be a boon to all who desire to calculate ephemerides of short-period comets or minor planets. *A propos* of the latter point, it may be mentioned that the ephemeris of Ceres given in NATURE of December 9 is found to need the large correction of *minus* 4m. 40s. in right ascension. This large discordance emphasises the inconvenience resulting from the discontinuance of the accurate ephemerides of the four chief asteroids formerly published in the Nautical Almanac.

THE UCCLE OBSERVATORY.—Tome xiv., fascicule iii., of the *Annales de l'Observatoire Royal de Belgique* shows that a considerable output of work went on at the Uccle Observatory even during the dark days of war. It contains micrometric measurements of 172 double stars made with the 38-cm. equatorial by G. van Biesbroeck. The mean result for Castor (epoch 1914·142) is 219·59°, 5·30″. The distance shows a marked diminution since about 1890, when the maximum, 5·76″, was reached. So far as it goes, the above observation favours Mr. Lewis's minimum ellipse, the period of which is 310 years.

The *Annales* also contain a very fine series of cometary observations extending from 1913 to 1919; for example, Delavan's comet of 1913 was observed for position on seventy-three nights, and its magnitude determined on thirty-two nights. It remained a naked-eye object for nearly six months, attaining a maximum of 2·8 magnitude in mid-September, 1914. Among other methods that of extrafocal images was largely used. The comparison stars are thus expanded into discs, which renders them more readily comparable with a diffused body like a comet.

Colloid Chemistry.

By PROF. W. C. McC. LEWIS.

COLLOID chemistry—the science which deals with the phenomena occurring at the interfaces which separate two contiguous phases, such interfaces being very large in extent relatively to the actual masses of the phases themselves—stands in a rather peculiar position. Numerous colloid problems are encountered by workers who in many cases fail to realise the significance of their observations from the point of view of colloid chemistry itself. The scope of the subject is so wide that it is not surprising to find the literature exceedingly scattered, and part of it not easily accessible. Many of the results and observations are rendered difficult to interpret, or even lose the greater part of their value, through insufficient attention having been paid to considerations which a general knowledge of colloid chemistry as a science would have suggested. For similar reasons there has been a considerable amount of overlapping and, in some cases, a distinct lack of agreement in results, which probably has its origin in unsuspected dissimilarity in the conditions employed. With the literature, scientific and technical, in this state it is evident that considerable good might be done by attempting to correlate such observations and results with the object of impressing the essential unity of the subject upon those engaged in problems apparently diverse. Such an attempt at co-ordination has been made by the Colloid Committee of the British Association, which has just issued its third report.[1]

This report, following the plan already adopted in the two previous reports, contains the subject-matter arranged under two heads: (1) classification according to scientific subject, and (2) classification according to industrial process. Under the first head the following subjects have been dealt with: Colloid Chemistry of Soap Solutions; Ultra-microscopy; Solubility of Gases in Colloidal Solutions; Electrical Charge on Colloids; and Imbibition of Gels. Under the second head we find: Industrial Applications of the Imbibition of Gels; Colloid Problems in Bread-making; Colloid Problems in Photography; Cellulose Esters; Colloid Chemistry of Petroleum and of Asphalt; Varnishes, Paints, and Pigments; and Clays and Clay Products.

Merely to read over the list of industrial subjects dealt with in this and in the two previous reports is sufficient to indicate the extraordinarily wide technical field in which colloid considerations play a decisive part. At the same time one cannot but be struck by the predominance of empiricism in almost all cases, and, consequently, the urgent need there is for each industry to investigate its own colloid problems on scientific lines. The Committee will have done something if it succeeds in emphasising this fact.

Unfortunately, at the present time the retort may well be made that broad scientific principles in colloid operations and processes are few, and that even the simplest colloid phenomenon is by no means completely understood. By way of illustration, let us take the case of the stability of a colloidal metal in a dispersing medium such as water. Are we to take it as true that small particles consisting of pure metal only are capable of permanent distribution in a pure solvent, or is it always necessary to have some "impurity" present to stabilise the system? We know that a finely divided metal such as that considered carries an electric charge, but we have not any notion of its magnitude; and although we know that it can be discharged, the mechanism is not altogether clear. Does the stability of the colloid system depend on the existence of the charge alone or upon the magnitude of the interfacial tension round each individual particle, or upon both effects; and, if so, in what manner? Is there a real limiting size to such particles, and, if so, what opposing agencies determine the size and how do they operate? In the peptisation of such particles, say by the addition of gelatin, does the peptiser form an actual coating round each individual? If so, what are its properties, and what relation does the amount of bound peptiser bear to that still left free in the liquid? We know that peptising effects are highly specific. What determines the specific nature of the effect? Again, what is the mechanism of coagulation, and why are certain coagulations reversible and others not? Numerous queries of this kind naturally occur even in connection with a problem which is only one of many included in the term "colloid chemistry," and it may be said with confidence that to answer at all adequately some of these queries will require many years of intensive scientific investigation. Further, it must be borne in mind that several technical processes in active operation at the present time depend directly upon such phenomena as stability of dispersed systems, peptisation, and coagulation. It is obvious that effective control and ultimate extension of such industries must involve a scientific knowledge of what is taking place.

Let us turn for a moment to some of those aspects of colloid phenomena upon which we may be said to possess some real *quantitative*, though necessarily incomplete, knowledge. First of all we have Willard Gibbs's theoretical investigation of the influence of an interface upon the concentration of gaseous and dissolved substances. A small section of Gibbs's work has led to the only quantitative law of adsorption by capillary forces which we possess, and it seems not improbable that other generalisations still lie unheeded in his famous essay. Next we have Donnan's quantitative investigation of the effect of a chemically inert membrane upon the distribution of electrolytes when electrolytic colloidal material is present on one side of the membrane, leading to the phenomena of membrane hydrolysis and membrane potentials. To this we must add the application of Donnan's method of treatment in the hands of Procter and of Wilson to the imbibition of gels and the process of vegetable tanning. Next we have the quantitative investigations and generalisations of McBain, of Bayliss, and of Pauli upon the composition and behaviour of colloidal electrolytes, such as the soaps and the proteins, as a function of the dilution of the system. We have, too, the work of Perrin, of Gee, and of Bancroft on the mechanism of electrical endosmose. We have the beginnings of a science of electro-capillarity in the work of Lipomann and of Helmholtz. Our knowledge of the molecular and atomic mechanism of condensation upon surfaces has been greatly increased by the novel ideas of Langmuir and of Harkins—a subject of the utmost importance in connection with heterogeneous catalysis generally. We know something, though not a great deal, about such phenomena as the viscosity of colloidal solutions, the rigidity of surface films, the mechanism of lubrication, the Liesegang phenomenon, and other typically colloid-chemical problems. The fact is that an enormous field exists the scope of which is by no means realised

[1] Department of Scientific and Industrial Research. British Association for the Advancement of Science. Third Report on Colloid Chemistry and its General and Industrial Applications. Pp. ii+154. (London: H.M. Stationery Office, 1920.) Price 2s. 6d. net.

by scientific investigators in general or by those actually engaged in technical problems which involve, either partly or wholly, considerations of a definitely colloid nature.

The reports of the British Association Committee on Colloids have dealt with a number of the subjects referred to above, and also in some detail with a number of industrial operations involving colloid chemistry. Several scientific subjects and technical applications have not as yet been included. It is hoped that a number of these will form the subject-matter of the fourth report.

A New Problem of Coastal Navigation.

IN coastal navigation there is no problem of greater general utility than that of fixing positions by means of "cross-bearings" of two terrestrial objects. If, for instance, we have one object bearing due north and a second bearing due east, we have but to lay down the bearings reversed, south from the one and west from the other, and the point of intersection of the two lines of bearing fixes the position of the ship.

When, as is often the case, only one light is available, it has generally been assumed that no more information could be obtained from its observed bearing than a single line of bearing, somewhere upon which the ship's position must lie. But a little work recently published in Australia[1] by Capt. H. H. Edmonds, of the British Mercantile Marine, introduces us to a comparatively novel use for a single light, for he shows how by three bearings, with the intervals between the bearings noted, we may deduce that most valuable piece of information, the actual course under the influence of wind and current which is being made good "over the ground."

The problem is not wholly new, for in its most general form questions to be solved by protraction have been proposed in recent years in the Board of Trade examinations for masters and mates, but in much too complicated a form to be of service in actual work at sea. The advance effected by Capt. Edmonds lies in the application of a simple form of table, reference to which gives the course made good in a moment with no more trouble than the division of one quantity by another.

In the construction of the table it is assumed that the intervals in azimuth are equal, the times of the three observations being carefully noted. One of these being divided by the other, a "ratio" is obtained which serves as an argument of the table.

The use of the table will easily appear from one of the examples given: "A light bore N.W.; after a time-interval of 39 minutes it bore W.N.W.; after another time-interval of 21 minutes it bore W."

A portion of the table to be employed is given below:

Bearing interval 22° 30′.	
Course angle.	Ratio.
31°	1·884
32°	1·839
33°	1·796

The solution is given as follows: "Dividing the greater time-interval by the lesser, we obtain a ratio 1·857; with this ratio, under bearing 22½°, we obtain the course-angle 32°, which, allowed forward of the first bearing, gives course made good N. 13° W."

The table of the text-book, as has been shown, proceeds upon the assumption that the intervals in azimuth should be equal. A still more advantageous form of table, it would seem, could be obtained by taking the observations at equal intervals of time, with differences of bearing in general unequal. This form of table presents at least two very attractive features: first, that we have no ratio to calculate, and, secondly, that it is much simpler in practice to observe a bearing at a given time by watch than to wait, watch in hand, at the compass until a given bearing comes on. For air navigation in particular such a table should be invaluable, since it is quite unnecessary to fix the identity of the particular point observed, and, indeed, the problem has already engaged the attention of some of the able men who have taken up the problems connected with the navigation of the air. In a recently published work by Lieut. Dumbleton[2] the following passage occurs, taken apparently from a lecture by Squadron-Leader Wimperis before the Royal Aeronautical Society: "How is one, then, to determine the course being made good? Perhaps the best method is to take times and bearings of the object as it passes through the points E, F, and G, such that the time from E to F is equal to the time from F to G."

The lecturer goes on to describe a method of solving the problem by protraction, suitable, perhaps, for an airship, but scarcely practicable probably for a heavier-than-air machine.

The following extract shows the form which such a table, devised for equal differences of time, would assume:

Angle of Inclination to First Line of Bearing.

Difference between first and second bearings.	Difference between second and third bearings.					
	56°	F.	54°	F.	52°	F.
38° ...	35·2°	0·74	36·5°	0·76	38·0°	0·78
36° ...	34·7°	0·71	36·0°	0·73	37·4°	0·75
34° ...	34·0°	0·68	35·3°	0·69	36·7°	0·71
32° ...	33·2°	0·64	34·4°	0·66	35·7°	0·67
30° ...	32·1°	0·60	33·3°	0·62	34·6°	0·64

The column marked F requires, perhaps, some explanation. The primary object of the table is to give the course made good. But when at first bearing the distance from light is known with reasonable accuracy, the distance in final position is obtained by multiplying first distance by factor F. The following example will serve to illustrate the use of the table:

From a ship steaming N. 25° W. 16 knots, the Smalls Light (lat. 51° 44′ N., long. 5° 40′ W.) bore N. 26° E. Twenty minutes later the Light bore N. 59° E., and again after a further twenty minutes S. 67° E. Find true course made good.

For first difference of bearing we have $59°-26°=33°$, and for second $113°-59°=54°$.

Entering table with 33° on left and 54° at top of the page, we have the angle 35° nearly.

This angle applied to the first bearing, N. 26° E., gives N. 9° W. as true course made good over the ground.

To illustrate the use of the factor F, let us suppose that by means of the line of position from a star observation or otherwise, distance at first bearing was found to be 10 miles. Then final distance $=10\times F=10\times 0{\cdot}68=6{\cdot}8$ miles.

[1] "Course Angle Tables for Finding a Course Made Good." By H. H. Edmonds. (Sydney: Turner and Henderson.)

[2] "Principles and Practice of Aerial Navigation." By Lieut. J. E. Dumbleton. (London: Crosby Lockwood and Son.)

The position of the Smalls Light, it may be observed, is such that it offers special advantages for the application of the proposed method. A ship rounding the Land's End, bound for the Irish Channel, after passing the Longships Light, has a run of about 130 miles for the Tuskar Light, and towards the end the tidal currents set across the mouth of the Channel with considerable velocity. In such a case observations of the Smalls Light, should it become visible on the starboard bow, would be of considerable service in checking the course laid for the Tuskar.

H. B. G.

Late Keltic Remains from a Mendip Cave.

AN important series of Late Keltic objects has been brought to light by members of the Speleological Society of the University of Bristol in the course of investigations in a cave in the Mendips. The cave was first discovered in September, 1919, and the work of exploration, which has been done on most systematic lines, has been carried on throughout the past year. The finds, which were described by Mr. L. S. Palmer at a recent meeting of the Royal Anthropological Institute, included objects of worked bone and stone, bronze hubs and bands of chariot-wheels, bronze bracelets and finger-rings, iron slave shackles, an iron key, spindle whorls, and similar objects. A considerable amount of pottery was also found which in design and technique was comparable to that found in most Late Keltic settlements. It does not, however, exhibit the characteristic curvilinear motives, the chief decorative feature being in the form of an inverted C. Only three human bones were discovered. There was a large number of bones of domestic and wild animals. A peculiar feature of the discovery is that all these objects were found either on the surface of the floor of the cave or in a thin band of mud which constituted the uppermost layer. There was no evidence of earlier occupation or any trace of Roman occupation. These facts, taken in conjunction with evidence which points to occupation of the cave having taken place in abnormal circumstances, would suggest that the cavern was used as a temporary refuge.

The discovery is of great importance in connection with the question of the relations which subsisted between this country and the Continent during the Iron age. The character of the finds, and in particular the close affinity exhibited by the pottery to that of Brittany, pointed, in Mr. Palmer's opinion, to the site having been occupied by a tribe of the Brythons who migrated to this country from the north of France. The same people built Glastonbury Lake Village, and are known to have inhabited Wookey Hole, Worlebury Camp, and some hut circles on Brean Down, all of which are within a few miles of this cave. In support of his view Mr. Palmer pointed out that the hill forts in this area all face in a northerly direction, which would suggest that they were the van of a wave of immigration from the south. On the other hand, as Prof. Keith pointed out, the type of skull usually associated with this type of culture in the west of England differs essentially from the Breton skull, and the affinity between the pottery of this area and that of Brittany may well be the result of commerce rather than of immigration. It may be hoped that the further exploration of the site which is to be carried on during the coming year may produce fresh evidence to throw light upon a period concerning which our present knowledge is all too scanty.

Physiology at the British Association.

ON Tuesday, August 24, the Section of Physiology held a joint meeting with the Sub-Section of Psychology. At this joint sitting Dr. Rivers opened a discussion on the desirability of establishing a separate Section of Psychology. The address of the chairman of the Sub-Section (Dr. C. S. Myers) was on almost the same subject. Dr. Rivers gave an outline of the history of psychology in relation to the British Association, and showed that there had been a great increase in the number of papers on psychological subjects contributed to the Association. He pointed out that psychology had developed methods and problems of its own. At the end of the discussion Dr. Rivers moved a resolution: "That this meeting of the Section approves of the constitution of a separate Section of Psychology." This resolution was passed *nem. con.*, and it was referred to the committee of the Section.

At the same joint meeting Miss M. Smith and Dr. W. McDougall read a paper on "The Effect of Drugs on Fatigue." Fatigue was induced by sitting up all night for three successive nights, and the effect was studied by means of dotting circles on a moving tape and by memory tests with related words. The first effect of fatigue was to increase the efficiency, but after the first few days the efficiency showed a marked decline and remained below the normal for from sixteen to nineteen days. This showed that the effect of the loss of sleep extended for a considerable period after the loss of sleep had occurred. The drugs were given disguised so that they could not be recognised. Most of the experiments were with alcohol or opium. The action of alcohol was to decrease the efficiency except during the period of recovery, when a stage occurred in which alcohol caused the efficiency to approach the normal non-fatigued value. Opium caused an increase in efficiency which was more marked in the recovery stage. When the dotting and memory tests were carried out together alcohol caused them to vary together, and the subjective effect was not unpleasant, but opium caused one process to improve at the expense of the other, and the subjective effect was distinctly unpleasant.

On Friday, August 27, the Section of Physiology met the Section of Botany to discuss "Biochemistry and Systematic Relationship." An account of this discussion appears in the article upon the proceedings of the Section of Botany (p. 550).

Several of the meetings of the Section were held in the new buildings for the department of physiology, when the members of the Section had the privilege of inspecting the excellent accommodation for the department. At one of these meetings Prof. Haycraft demonstrated a new pulse recorder, which consists of a mirror resting on the artery, the records being made by photographing the movement of a spot of light reflected from the mirror.

Dr. T. Lewis read a paper on "The Relation of Physiology to Medicine." This was largely a plea

for the development of the subject of human physiology. He pointed out the importance of a knowledge of physiology for rational medicine, but contended that it would be of greater value if more use were made of the human subject for illustrating the facts of physiology. The use of methods of examination applicable to the human subject should be extended, but, of course, the methods must be controlled by experiments on animals. Dr. Lewis finished his paper by appealing to the citizens of South Wales for an endowment for the department of physiology. As a graduate from South Wales, he felt the handicap due to lack of accommodation and of equipment; now that a good building had been provided he hoped that sufficient money would be forthcoming for its equipment and upkeep.

As a good example of the way in which animal experiments must be used to elucidate the physiology of the human subject Dr. Lewis's paper on "Auricular Flutter" may be quoted. This was a description of experiments on the heart of the dog. The time-relations of electrical changes in the auricle were traced, and they were found to differ from those of the auricle beating in its natural way. The evidence from the time-relations of the electrical changes points to a wave of contraction passing round the superior and inferior venæ cavæ. The normal beat consists of a contraction wave which spreads over the whole auricle, but in auricular flutter the wave travels down one side of the auricle round the inferior vena cava, and returns by the other side of the auricle to the superior vena cava. This establishes a circus movement which continues indefinitely. The wave of excitation reaches each part of the auricle at a sufficient interval after the previous contraction to fall outside the refractory period; hence the series of quickly following circus movements. The normal contraction ends because the wave of contraction spreads fan-like over the whole auricle, when it reaches the limits of the auricle: it ceases because the wave of excitation is dammed by the refractory period of the contracting auricle.

Miss E. Bedale, in collaboration with others, read a paper on "The Energy Requirements of School-children." The measurement of energy was attempted in two ways. The first consisted in obtaining diet-sheets prepared by the pupils on which they recorded the weighed amounts of the various food materials eaten. These diets were evaluated by analytical data, and the energy-value of the diet was obtained in that way. The second method was to measure the energy expenditure by means of the respiratory exchange. The basal metabolism was measured during sleep. Measurements of the respiratory exchange were made during various forms of activity and the daily expenditure was estimated by a calculation involving the amount of time occupied in the different forms of activity. The two energy values did not agree, the intake of energy being greater than the expenditure. It was left an open question as to how much of the lack of agreement was due to errors in computing the energy output in the various forms of activity during the day.

Prof. Waller gave some figures on an allied subject in which he measured the energy expenditure by the output of carbon dioxide. He contrasted a man in training with an untrained man running the same distance at the same speed. Assuming that the basal metabolism of the two men was the same, the untrained man expended double the amount of energy in doing the same work.

Prof. Herring recorded measurements showing the effect of pregnancy on the various organs of the white rat. The animals were from a standard litter, and kept under identical conditions except for the occurrence of pregnancy in some of them. Most of the organs showed a slight decrease in weight; the only ones that showed an increase in weight were the liver and the adrenals. The increase in the former shows the great importance of metabolism during pregnancy. The increase in the latter is probably in the cortex, and not in the medulla.

Dr. Edridge-Green read a paper on "The Prevention of Myopia," in which he stated that the exciting cause of myopia is an increase in intra-ocular pressure. Games such as cricket, football, golf, etc., do not cause myopia, but severe strains such as lifting heavy weights, especially with the eyes pointing downwards, should be avoided.

Prof. Waller recorded some further observations on "The Emotive Response of the Human Subject." The response is usually confined to the hand and foot, but a few individuals show it on the forearm and leg. The reaction appears first on the hand ($2''$) and then on the foot ($3''$). If it occurs elsewhere it is delayed as long on the arm as on the foot ($3''$), and shows a longer latent interval on the leg ($4''$).

Prof. Waller presented the report of the Committee on Electromotive Phenomena in Plants. The zone of growth in iris is at the base of the leaf, and in anemone at the apex of the plant. When an induction shock is passed through an active growing tissue the resultant electrical change is always from the more active to the less active portion in the plant-tissue, no matter in which direction the stimulating current is passed. In dead tissues the current produced after stimulation is small, and always in the direction of polarisation.

Botany at the British Association.

THE diversified character of modern botany was well exemplified in the programme of the Cardiff meeting, and the *rapprochement* of the sciences was evidenced by the three joint discussions in which the Section took part. Joint sittings have become an important feature of recent years, and in this reflect the tendency of modern research to overstep the necessarily arbitrary boundaries of the so-called sciences and to combine with other workers on the border-line problems.

Thus it is not surprising to find botanists co-operating with zoologists and geologists to consider whether Mendelian work and palæontological evidence show as yet any sign of giving mutual support to the conclusions derived from each line independently.

The joint discussion with the physiologists and chemists entitled "Biochemistry and Systematic Relationships," presided over by Miss Saunders, president of the Botany Section, aimed at considering whether the present state of knowledge indicates any definite ratio between biochemical constitution and morphological expression—that is to say, does biochemical investigation show a chemical relationship in the forms which have long been grouped together on morphological grounds? The discussion was introduced by a paper by the Hon. Mrs. Onslow, wherein the possibility of expressing reproductive and vegetative characters in chemical terms was explored; lines of plant-metabolism were considered and suggestions made as to correlations between the evolution of the families of flowering plants and the presence of oxygenases, and the distribution of anthocyan pigments and of flavones was discussed. The papers and open discussion which followed indicated the importance of the new line of work, inasmuch as a considerable correspondence of chemical and morphological relationship had been established, but laid stress also on the necessity for extreme carefulness in its application in view of the

diversity in many cases of chemical reactions in closely related forms.

Dr. F. F. Blackman contributed a paper on "The Biochemistry of Carbohydrate Production in Plants from the Point of View of Systematic Relationship," in which the distribution of the primary products of the photo-reduction of CO_2 in different groups of plants was traced, pentoses being the basis of the succulent habit, and the diversity of the condensation products, saccharose, starch, and inulin, was considered in relation to species and families. Emphasis was laid upon Reichert's work on the individuality of the starch-grains of every species of plant, and of its bearing on the chemical specificity of protoplasms. Prof. G. H. Nuttall followed with a paper entitled "Precipitin Reactions as a Means of Determining Systematic Relationships in Animals and Plants," in which it was pointed out that both animal and vegetable albumins retain certain chemical properties which persist, while the animal or plant to which they belong undergoes a phylogenetic morphological change, and that qualitative precipitin tests carried out with different albumins give a measure of the degree of relationship existing between forms that have descended from a common stock. The contribution of Mr. J. Barcroft (president of Section I) correlated the properties of the oxygen-carrying power of blood, essentially the properties of hæmoglobin, with the functions and habits of the animal in question rather than with its phylogeny, comparing in particular the oxyhæmoglobin equilibrium of fishes living in different habitats.

The semi-popular lecture which has become a feature of the Botany Section was delivered this year by Prof. Chamberlain, who came from Chicago to do so at the invitation of the committee. His eye-witness account of his adventurous acquaintance with the Cycads of the world delighted the audience no less than the beautiful lantern-slides which accompanied it.

Amongst other descriptive accounts of vegetation may be mentioned that of Prof. Chodat on some aspects of plant ecology and biology in Paraguay; that of Mr. Kingdon Ward on the distribution of floras in south-east Asia as affected by the Burma-Yunnan Ranges; that of Mr. Patton on the vegetation of Beinn Laiogh; and, lastly, a lantern demonstration of the Eastern Canadian Rocky Mountains by Prof. F. J. Lewis. Vegetation and soil surveys formed the subject of the joint meeting between the Sections of Botany and Agriculture, presided over by Prof. Keeble, president of the latter Section. Mr. G. W. Robinson dealt with the soil types of North Wales as revealed in the soil survey of recent years, and Mr. G. A. Fisher with soil acidity. Mr. Robinson suggested that, while uniformity in sampling and analytical methods should be secured, the classification of soils must depend on local conditions. In extreme humid conditions it would appear that differences due to geological factors tend to be obliterated. Large numbers of soil samples should be collected, and the types worked out from actual observations; correlation with geology may follow afterwards. The soil survey gives information as to *one* of the factors affecting plant-growth and, ultimately, agriculture in a particular area. The survey in its widest sense should take cognisance of all the other factors, including climate and soil-water conditions. The vegetation survey gives the results of the operation of all these factors.

Miss Wortham gave an account of the results of her survey of Anglesey and North Carnarvonshire, with special reference to the grass-lands, and showed that the plant-formations are closely related with the geological structure of the district. She traced the origin of grass-lands from upland moor, from woodland, and from the degeneration of lowland moor.

The botanical part of the discussion centred especially round types of grass-land, their importance in Wales and in general in agriculture, the possibility of fixing on some *standard* symbols of colours for ecological mapping, and the correlation of the various surveys. Prof. Stapledon, after discussing *Festuca agrostis* pastures in detail, laid stress on the need for a colour scheme which would allow of the representation of transition types. He also took up the question of the difficulties of the representation of arable, and suggested the possibility of using the weed flora in this connection. Lastly, Prof. Stapledon emphasised the immediate importance of hastening on the primary vegetation survey. As a result of the discussion, in which Sir Daniel Hall, Mr. T. J. Jenkin, Dr. E. N. Thomas, Mr. Morrison, and others took part, it became obvious that there existed a great need for co-operation among workers and more codification of observations. Steps were initiated with the view of bringing about this end.

The subject of geotropism, which has received considerable attention during the last few years, was considered on the Wednesday afternoon, when Dr. Harold Wager gave a paper on the geotropism of foliage leaves and their possible dia-geotropism. In a contribution entitled "Further Evidence for the Differentiation in Hydrion Concentration in Stem and in Root as the Explanation of Positive and Negative Geotropism," Prof. Small, in collaboration with Miss Rea, further developed his theory of the CO_2 balance as the cause of this differentiation in behaviour.

The only contribution to fossil botany was furnished by a paper by Mrs. Clement Reid on the history of the West European Pliocene flora as deciphered by the study of fossil seeds, in which, by the critical comparison of percentages which were then plotted as a curve, she demonstrated very clearly that seeds may be used to determine species and with strong probability for zoning purposes. Since Mrs. Reid's conclusions agree with those furnished by animal palæontology for known ages, they can be used for one unknown. The deductions from the curve based on the numerical study of plant species also agree with, and therefore support, many conclusions arrived at by stratigraphical and other evidence.

The president expressed special interest in a paper by Miss Blackburn on anomalies in microspore formation in Rosa and its possible connection with hybridity in the genus. The normal process had been examined in three species. Abnormalities were described in ten forms, two of which were known to be hybrids. The results suggested the possibility of determining the genetic constitution of forms by an examination of cytological phenomena.

Probably the most outstanding contribution of original work was supplied by Prof. Lloyd Williams, who gave a detailed account of his researches into the life-history of the Laminariaceæ, which demonstrated the existence of alternation of generations throughout the group.

Great interest was expressed in the progress reported by Mr. Martineau on the growth of pit-mound plantations in the Midlands, and a resolution was proposed by Sir Daniel Morris, seconded by Prof. Henry, and passed unanimously, urging State support for similar experiments in other parts of the country.

Notwithstanding the short time and crowded programme, the botanists were able to see something of the vegetation of the neighbourhood on their expeditions to the very beautiful country surrounding Cardiff.

University and Educational Intelligence.

LONDON.—On his resignation after twenty-seven years' service of the chair of botany at King's College the Senate of the University has conferred the title of emeritus professor of botany in the University on Dr. W. B. Bottomley.

The following doctorates have been conferred:—*D.Sc. in Geology:* Mr. H. A. Baker, an internal student, of University and Birkbeck Colleges, for a thesis entitled "On the Investigation of the Mechanical Constitution of Loose Arenaceous Sediments by the Method of Elutriation." *D.Sc. in Mathematics:* Mr. H. E. J. Curzon, an internal student, of University College, for a thesis entitled "The Reversal of Halphen's Transformation." *D.Sc. (Economics):* Mr. E. H. J. N. Dalton, an internal student, of the London School of Economics, for a thesis entitled "Some Aspects of the Inequality of Incomes in Modern Communities."

Dr. Harriette Chick has been awarded the William Julius Mickle fellowship, of the value of 200*l.*, in recognition of the important work she has carried out during the past five years on diseases due to defective nutrition.

DR. DAVID OWEN, senior lecturer in physics at the Birkbeck College, has been appointed head of the department of physics and mathematics at the Sir John Cass Technical Institute, Aldgate, E.C.3.

THE Drapers' Company has made a grant of 5000*l.* to the East London College (University of London) for the equipment of its new library. The remarkable growth and success of this University college in the Mile End Road, built up under the auspices of the Drapers' Company, form one of the outstanding features in modern educational activity. The undergraduates in the college now number nearly 600.

A MEETING for the purpose of considering the desirability of establishing a Federal Council of Associations of Teachers in Bristol, Gloucestershire, Somerset, and Wiltshire, held at the University of Bristol on December 4, was attended by representatives of numerous associations and institutions. Prof. J. Wertheimer was elected chairman, and it was decided that, subject to the approval of the majority of the associations represented, the council should be established. The objects of the council will be:—To bring together representatives of teachers of all types in order to give them opportunities of exchanging views, of becoming acquainted with one another's work, and of formulating, when desirable, expressions of opinion in regard to educational problems of general interest.

THE statement for the year 1919–20 of the Rhodes Scholarships Trust has been received. During that period 185 scholars, of whom 105 were from the British Empire and the remainder from the United States, were in residence; of this number 98 were freshmen. By the end of the year 32 of the scholars either completed the term of their scholarship or went down, in spite of which the present year opened with as many as 220 Rhodes scholars in residence. A record of the results achieved during the past year by holders of these scholarships is given, among which may be noted three students who were admitted to read for the degree of Ph.D. in natural sciences; while the books which have been published in the academic year by Rhodes scholars include a translation by Mr. H. L. Brose of Moritz Schlick's book entitled "Space and Time in Contemporary Physics."

IT is announced in the *Lancet* of December 18 that an anonymous donor has given 20,000*l.* for the endowment of the University chair of physiology at the Middlesex Hospital Medical School. The present occupant of the chair is Prof. Swale Vincent, who is well known for his publications dealing with the ductless glands and internal secretions. Prof. Vincent has one of the physicians of the hospital associated with him in his department in order to facilitate the introduction of new discoveries in the laboratories into medical practice in the clinical wards. This generous gift is a big step in the direction of the co-ordination of medical education with research and treatment which Lord Athlone, chairman of the hospital, is anxious to secure, and it will also form another bond in the relations between the hospital and London University. Of the six professorial chairs now existing in connection with the Middlesex Hospital that of physiology is the second to receive permanent endowment, the chair of physics having been endowed early in the present year.

THE first annual dinner of the Imperial College of Science and Technology, held on December 14, was an outward and visible sign of the common interests of the three constituent colleges—the Royal College of Science, the City and Guilds (Engineering) College, and the Royal School of Mines. The Marquess of Crewe, chairman of the governing body of the Imperial College, presided, and a large number of leading representatives of science and technology supported him. Several notable speeches were made in the course of the evening. Sir Alfred Keogh, rector of the college, said that long before the late conflict the college had been urging the principle of the relation of science to industry, which was the same thing as the relation of science to war, but neither the nation nor the Government had paid heed to it until the war broke out and it was found that war could not be waged without science. It was then that the three constituent colleges were able to render essential service in many fields. Lord Moulton said that science and technology were mutually complementary, science procuring the seed while technology used it to secure bountiful harvests for human needs. Sure success is built upon accurate knowledge such as the college diffuses in all its branches. The Marquess of Crewe remarked that the Imperial College has all the attributes of a university, and the courses taken by its students are no more specialised than those pursued by science students in the older seats of learning. He followed with much interest the progress of the University of London, and it was hoped that the college would advance on parallel, but not on identical, lines, both institutions agreeing to pursue the twin figures of knowledge and wisdom in still wider fields.

A CONFERENCE on recent advances in physics will be held in the physics laboratory of the University of Toronto between January 5 and 26 of the coming year. The principal event will be a series of eighteen lectures by Dr. L. Silberstein on "The Special and Generalised Theories of Relativity and Gravitation" and on some of the recent advances in spectroscopy and the theory of atomic structure. Einstein's theories of general relativity and gravitation, and the more recent theory of electromagnetism put forward by Weyl, will occupy some five or six lectures, and a similar period will be devoted to Bohr's quantum theory of spectra, Sommerfeld's relativistic theory of the structure of spectral lines, the Epstein theory of the Stark effect, and the lecturer's own theory of non-spherical nuclei. The course will be mainly mathematical in character. Dr. Irving Langmuir will deliver a short course of lectures on the theories of atomic structure and allied subjects from the chemical as well as from the physical aspect. Prof. E. F. Burton is giving a course of twelve lectures on the fundamental properties of colloidal solutions, which

it is hoped will be as useful and interesting to manufacturers as to men of science. Sixteen lectures of a popular nature dealing with various aspects of recent researches on the structure of matter and on the origin and characteristics of radiation will be delivered by Prof. J. C. McLennan, who will deal chiefly with the results of the experimental investigations which have been made in numerous branches of the subject, concluding with an account of the production and uses of helium. The conference will be opened on Wednesday, January 5, by Sir Robert Falconer, president of the University of Toronto.

Societies and Academies.

LONDON.

Royal Society, December 9.—Prof. C. S. Sherrington, president, in the chair.—Lord **Rayleigh**: Double refraction and crystalline structure of silica glass. Although glasses in general have no double refraction, except that due to bad annealing, yet silica glass is found to have a doubly refracting structure which cannot be so accounted for, and must rather be regarded as crystalline. The double refraction is very weak, of the order of 1/60 that of crystalline quartz. In a mass of silica which has been melted, but not drawn or blown, the structure consists of doubly refracting grains with dimensions of about ½ mm., oriented at random. If the grained material is drawn out while soft, the grains are elongated into crystalline fibres or ribbons. Fused silica sometimes contains isolated, small inclusions of quartz with angular outlines which have escaped vitrification. These are conspicuous in the polariscope by the strain effects they produce in the surrounding glass.—Prof. J. W. **Nicholson** and Prof. T. R. **Merton**: The effect of asymmetry on wave-length determinations. (1) The apparent displacement of an unsymmetrical spectrum line caused by the finite resolving power of the spectroscope can be calculated on certain simple assumptions. (2) The displacement is independent of the actual widths of the lines. (3) It is considered that the general practice of measuring spectrum lines to a degree of accuracy far transcending the resolving power is not justified.—Prof. T. R. **Merton**: The effect of concentration on the spectra of luminous gases. Certain spectroscopic phenomena appear to be associated with the concentration of the radiating atoms in the source. An increase in concentration may result in a broadening of the lines, a change in the structure of the lines, and changes in the relative intensities. Sources containing lithium exhibit these three phenomena, and the broadening is familiar in sodium flames. A study has been made of the behaviour of sources containing sodium and lithium. The results seem to exclude a temporary association of atoms as the cause of the changes, for the addition of large quantities of sodium to a source containing a trace of lithium produces no change in the lithium spectra. Mixtures of hydrogen and helium have also been investigated. The broadened lines of both these elements from vacuum tubes excited by condensed discharges are accounted for completely by the electrical resolution of the lines by the electric fields of neighbouring charged particles.—Prof. E. **Wilson**: The measurement of low magnetic susceptibility by an instrument of new type. The paper deals with the design, construction, and working of an instrument for the measurement of susceptibility (of low order) over a wide range of magnetic force, and thus avoids the difficulty met with in the Curie balance, the defections of which follow the square law, and, in fact, limit the measurement of susceptibility of a given specimen to a very narrow range of magnetic force. The force due to torsion in a suspending fibre is replaced by an electromagnetic system in which the mechanical force is due to two components—one proportional to the magnetic force impressed upon the specimen and the other variable if the susceptibility varies. The expression for the susceptibility is that of the reciprocal of a resistance multiplied by a constant, and thus the instrument lends itself to great accuracy in the detection of variations in susceptibility.—Prof. W. T. **David**: The internal energy of inflammable mixtures of coal-gas and air after explosion. In the first part of this paper an empirical law of cooling of exploded mixtures of coal-gas and air contained in a closed vessel has been formulated. This is based upon measurements of the heat loss by conduction and by radiation made during the explosion and later cooling of the inflammable mixtures. In the second part the heat-loss measurements have been applied to the estimation of the internal energy of the gaseous mixtures at the moment of maximum temperature and at various stages during cooling.—Prof. A. **McAulay**: Multenions and differential invariants. The paper is a summary of the properties of a linear associative algebra suitable for electromagnetic relations, differential invariants, and relativity. There are n fundamental units, otherwise it is the same algebra as that considered in a paper by W. J. Johnson and read to the Royal Society on November 20, 1919.

Aristotelian Society, December 6.—Prof. T. P. Nunn in the chair.—Prof. W. P. **Montague**: Variation, heredity, and consciousness: a mechanist answer to the vitalist challenge. It was attempted to show that it is possible to point out a solution of the problems of phylogeny, ontogeny, and consciousness, statable in mechanistic terms, which provides full satisfaction to the demand of the vitalist that the purposive and psychic characters of life shall not be reduced to an epiphenomenal status of dependence upon blind processes. The occurrence of useful variations in the germ-plasm in greater frequency than is explicable on recognisable mechanistic principles may be explained by the conception of biological vectors, according to which the unpurposed, yet purposeful, products of telogenesis in the germ-plasm and in the brain, when occupied with creative imagination, are results of a system of protoplasmic stresses. The problem of the many hereditary determinants in the minute germ-cell may be met by conceiving the germ as a system of superforces or superimposed stresses which are the embodiments of a manifold of invisible intensive determinants equal in richness to the serial events of the germ's ancestral past, and capable of reproducing its pattern by induction during embryonic growth. The problem of explaining mind in physical terms was met by suggesting that the structure of conscious life is analogous to the structure of life in general, except that the system of cerebral superforces in which the past is stored up in the present is composed of traces of potential energy acquired by the brain through the transformation of the kinetic energies of sensory nerve-currents. A new category, "anergy," was proposed as a measure of the form of durational being produced whenever the energy of motion is transformed into the invisible or potential phase.

Linnean Society, December 9.—Dr. A. Smith Woodward, president, in the chair.—Prof. E. S. **Goodrich**: Hymenopterous parasites of grain-infesting insects.—L. V. **Lester-Garland**: Plants from Darfur collected by Capt. Lynes, R.N., with remarks on their geographical distribution.—Dr. B. Daydon **Jackson**: The Norsemen in Canada in A.D. 1000, with the plants they reported. The course followed by the Norsemen was narrated, from their colonies in Greenland, across

Davis Strait, to the north-east coast of Labrador, southward through Belle Isle Strait to the valley of the St. Lawrence and the tract of country on its right bank, where vines were found growing, unsown corn, and a tree called "Masur," these being regarded as *Vitis labrusca*, L., *Zizania aquatica*, L., and an Acer. The reasons why these voyages were not continued were explained as due to the weak colonies at that time in Greenland, the actual starting-point, and the opposition of the natives, termed "Skrællings," who prevented any attempts at settlements in "Vinland"—the Wineland of the sagas of Erik the Red and of Thorfinn Karlsefni—the northern part of New Brunswick.

Royal Meteorological Society, December 15.—Mr. R. H. Hooker, president, in the chair.—C. K. M. **Douglas**: Temperature variations in the lowest 4 km. The chief object of this paper is to emphasise the importance of the source of the air-supply in causing variations of the upper-air temperature, and to discuss the relationship of these variations to the weather changes, with special reference to the theories of Prof. V. Bjerknes, which the observations strongly support. The view put forward is certainly not disproved by statistical results, though the evidence for it is derived chiefly from the study of a large number of observations of temperature and humidity in the upper air, in conjunction with synoptic charts. Among the associated points mentioned in the paper the following may be emphasised: (1) Both troughs of low pressure and wedges of high pressure normally lie farther west in the upper air than at the surface. (2) The pressure in the upper air may be regarded as being partly a consequence, and not purely a cause, of the temperature of the underlying column. (3) Very powerful wind-currents are observed at great heights between the polar and the equatorial air at those levels.—A. P. **Wainwright**: A sunshine recorder (mechanical type). The new type of sunshine recorder is in the form of two mercury thermometers similar to one another and of fairly large capacity. The bulb of one thermometer, which is contained in a vacuum, is exposed to the direct rays of the sun, while the other is contained in the shade of a Stevenson screen. The difference in expansion of the mercury in each bulb is recorded mechanically by means of a pointer on a clockwork drum, and denotes the varying intensity of the sun's radiant heat at any hour of the day. The object of this instrument is to obtain a more detailed record of sunshine, and in particular to show the total intensity of the sun's rays for the day as apart from the number of hours during which the sun has actually put in an appearance.—Lt.-Col. J. E. E. **Craster**: An investigation of river-flow, rainfall, and evaporation records. Measurements of the flow of the Shannon show a fluctuation due to variations in the amount of rainfall and evaporation in the Shannon basin. Rainfall records for the Shannon basin are few, and there are no evaporation records, so that it is not possible at present to determine the amount of rainfall and evaporation by direct methods. But the monthly variations of the rainfall and evaporation, expressed as fractions of the total annual rainfall and evaporation, are constant over large areas. Records of evaporation from the soil have been kept at Rothamsted for many years, and in the absence of any Irish records it has been necessary to employ these. By using the monthly variations of rainfall and evaporation as described above it is possible to determine the minimum annual rainfall and evaporation in the Shannon basin, which will account for the fluctuations in the river flow. The minimum annual rainfall has been found to be 45·71 in., and the minimum annual evaporation from the soil 16·88 in.

MANCHESTER.

Literary and Philosophical Society, November 16.—Sir Henry A. Miers, president, in the chair.—A. E. **Heath**: The disinterested character of science in view of certain of its working maxims. The object of this paper was to show that Mach's "principle of economy" and Occam's "principle of parsimony" are not—as would appear on the surface—contradictory. It was contended that the sciences are synthetic, and consist in the setting up of conceptual constructions for the complete description of the fields of primary fact in each science. When alternative conceptual constructions are possible Mach's principle is used to decide between the alternatives. But the constant reference back to the field of primary fact removes from its use any menace to the disinterested character of science. Occam's principle, however, is a maxim applicable only to a process opposite in direction to the synthetic advance of the sciences, namely, the analysis of the field of primary fact itself. It is, therefore, not contradictory, but complementary, to the principle of economy.

Literary and Philosophical Society (Chemical Section), October 29.—Mr. J. H. Lester (chairman) in the chair.—J. H. **Lester**: Address on "The Textile Chemist." The value of a thorough training in physics was emphasised, and the importance of a post-graduate training in a technical college considered. The chemist in a dye-making works is only a textile chemist when he deals with the textile process of dyeing.

November 29.—Mr. J. H. Lester (chairman) in the chair.—H. E. **Potts**: How can the results of chemical research be best protected by patents? If the patent agent studied the subject sufficiently to criticise freely and intelligently the research programme, the requirements of the law could be met and the research at one and the same time assisted.

EDINBURGH.

Royal Society, December 6.—Prof. F. O. Bower, president, in the chair.—Miss A. **Mann**: Observations on the behaviour of the endodermis in the secondarily thickened root of *Dracaena fruticosa*, Koch. The paper demonstrated the effect of cambial activity in disintegrating the endodermis and establishing channels for direct ventilation between the cortex and the pith, which are otherwise isolated by the continuous endodermal sheath. Frequently where such a disintegration takes place the endodermis is not so easily recognised. Here it is a strongly indurated layer of cells, so that the detail of the disintegration can be accurately followed. The physiological result is that the large roots where secondary thickening occurs have a common ventilating system; but small roots, where the point is less vital, have the cortex strictly delimited by the endodermis from the central pith.—L. F. **Spath**: Cretaceous Ammonoidea from Angola collected by Prof. J. W. Gregory (with notes by the late G. C. Crick). These Ammonites formed part of a collection that included the Brachiopoda and Mollusca dealt with by R. B. Newton in a paper already published (Trans. R.S.E., vol. li.). The fauna was there described as belonging to the Vraconnian stage of the Cretaceous series, which includes the zone of *Schloenbachia inflata*. Since there is great confusion about this more or less universal "zone" and about the Ammonites found in it, an attempt had to be made to trace the interrelations of the numerous keeled Ammonites of the Gault and their ranges in time. Some new genera are proposed in addition to a classification of the Hoplitids in general, and a subdivision of the various horizons of

the Upper Albian is offered. The specific descriptions deal with sixty different forms belonging to twelve genera. Some of these represent new, indeterminable, or doubtful species; but the genus to which *A. inflatus* itself belongs includes 50 per cent. of the total number of specimens. An analysis shows that half the number represent local types, some also occurring in the Albian of North Africa; but all the types common with Madagascar and India also occur in the European Gault—that is to say, what intermixture of Indian or American elements there is must have taken place *via* Thetys. The Ammonites do not include a single Cenomanian form. Some new facts of importance obtained from the study of various unworked collections in the British Museum from Angola, Nigeria, South and East Africa, and other localities are incorporated in this paper.

PARIS.

Academy of Sciences, November 29.—M. Henri Deslandres in the chair.—H. **Le Chatelier**: The phase rule. Some recent criticisms of the phase rule are based on misconceptions. A summary of Gibb's demonstration is given and some particular cases are examined in detail.—C. E. **Guillaume**: Cause of the instability of nickel-steels: its elimination (see p. 545).—C. **Sauvageau**: New observations on *Ectocarpus padinae*. The megaspores of this parasite on *Padina pavonia* can live and reproduce outside the plant acting as host; an alternation of generations between a summer parasitic plant and a winter plant of independent life is not improbable, although as yet unproved.—M. J. L. Breton was elected a free Academician in succession to the late M. Ad. Carnot.—R. **Birkeland**: The solution of the general equation of the fifth degree.—B. **Gambier**: The imaginary application of two real or imaginary surfaces. The corresponding real cyclic systems or triply orthogonal systems.—G. **Reboul**: A new property of substances feebly conducting electricity. If a photographic plate is covered with a sheet of black paper and placed in a dark box, and if two insulated electrodes with a potential difference of 1000 volts are brought into contact with the paper for a period of twenty-four to forty-eight hours, on developing the plate the fibres of the paper are found to be reproduced, and the equipotential lines also appear. If the paper is divided, or replaced by a sheet of metal or of mica, the effect is *nil* or confined to the electrodes. The effect can be modified by altering the conductivity of the sheet of paper.—S. **Procopiu**: The electrical dichroism of smoke and the dichroism of diffraction gratings.—S. **Posternak**: The constitution of the paramolybdates.—R. **Cornubert**: The spectrochemical study of the α-allyl and α-allylmethyl*cyclo*hexanones. The results are in agreement with the theory of Auwers on the influence of the double groups on the value of the molecular refraction.—C. **Dufraisse**: Remarks on the so-called dibenzoylmethane of J. Wislicenus. The author considers that the substance regarded by J. Wislicenus as dibenzoylmethane is, in reality, an ethylene oxide of the constitution

$$C_6H_5.CH—CH.CO.C_6H_5.$$
$$\diagdown O \diagup$$

—P. **Landrieu**: Researches on the acid and polyacid salts of monobasic acids: the potassium and lithium dibenzoates.—Mlle. Augusta **Hure**: The Lutecian limestone in the Yonne.—E. **Passemard**: The persistence of *Rhinoceros Mercki* in an Upper Mousterian deposit in the Basses-Pyrénées.—A. **Guilliermond**: New researches on the vacuole apparatus in plants. The vacuolar system in the embryonic cells of the higher plants frequently presents forms resembling mitochondria. These pseudo-mitochondrial forms do not show the histo-chemical characters of mitochondria, and should be definitely separated from the chondriome. The author considers the views of M. Dangeard with regard to the relation between these forms and the chondriome of the animal cell as erroneous.—L. **Daniel**: Researches on the grafting of Solanum.—L. **MacAuliffe** and A. **Marie**: The anthropometric study of 127 Spaniards.—M. **Baudouin**: The variations in the flattening of the tibia in infants and adults of the Neolithic races.—A. **Pézard**: Intrapuberal castration in cocks and the generalisation of the parabolic law of regression.—F. **Vlès** and J. **Bathellier**: The numerical laws of the pedal waves in the movements of Gasteropods.—P. **Wintrebert**: The comparative value and the determinism of the principal signs of aneural myotomic contraction observed in the embryos of *Scylliorhinus canicula*.—G. **Truffaut** and N. **Bezssonoff**: The characters common to the β bacterium, symbiotic with *Clostridium pastorianum* and *B. aliphaticum non liquefaciens*. The development of these two bacteria suggests that they belong to similar races, possibly to the same race.—G. **Odin**: A new method for the diagnosis of syphilis. Serum from the blood of the subject is mixed with physiological serum and a small proportion of sodium fluoride. The serum thus produced when injected into the patient increases all the syphilitic symptoms and makes a certain diagnosis. The method has been applied to more than a hundred cases without a single failure.

Books Received.

The Backward Peoples and our Relations with Them. By Sir Harry Johnston. (The World of To-day.) Pp. 64. (London: Oxford University Press.) 2s. 6d.

The Life of Horace Benedict de Saussure. By D. W. Freshfield. Pp. xii+479. (London: E. Arnold). 25s. net.

Home Mechanics Workshop Companion. By A. Jackson, jun. Pp. 222. (London: H. Frowde and Hodder and Stoughton.) 6s. net.

Home Soldering and Brazing. By R. F. Yates. Pp. 122. (London: H. Frowde and Hodder and Stoughton.) 4s. 6d. net.

Home Chemical Laboratory. By R. F. Yates. Pp. 127. (London: H. Frowde and Hodder and Stoughton.) 4s. 6d. net.

Soaring Flight: A Simple Mechanical Solution of the Problem. By Lt.-Col. R. de Villamil. Pp. 48. (London: C. Spon.) 1s. 6d. net.

Space and Time in Contemporary Physics. An Introduction to the Theory of Relativity and Gravitation. By Prof. M. Schlick. Translated by H. L. Brose. Pp. xi+89. (New York and London: Oxford University Press.) 6s. 6d. net.

The Geography of Plants. By Dr. M. E. Hardy. Pp. xii+327. (Oxford: Clarendon Press.) 7s. 6d. net.

Handbook of Spinning Tests for Cotton Growers. By Dr. W. L. Balls. Pp. 59. (London: Macmillan and Co., Ltd.) 3s. 6d. net.

Some Investigations in the Theory of Map Projections. By A. E. Young. Pp. viii+76. (London: Royal Geographical Society.) 6s. net.

Der Entropologische Gottesbeweis. By Dr. J. Schnippenkötter. Pp. 109. (Bonn: A. Marcus and E. Weber.) 15 marks.

Plane Algebraic Curves. By Prof. H. Hilton. Pp. xvi+388. (Oxford: Clarendon Press.) 28s. net.

Treatise on General and Industrial Organic

Chemistry. By Prof. E. Molinari. Translated from the third Italian edition by T. H. Pope. Part i. Pp. xv+456. (London: J. and A. Churchill.) 30s. net.

A Farmer's Handbook: A Manual for Students and Beginners. By R. C. Andrew. Pp. xvi+126+xliv plates. (London: G. Bell and Sons, Ltd.) 6s. net.

The World of Sound: Six Lectures delivered before a Juvenile Auditory at the Royal Institution, Christmas, 1919. By Sir W. Bragg. Pp. viii+196. (London: G. Bell and Sons, Ltd.) 6s. net.

Religion and the New Psychology: A Psycho-Analytic Study of Religion. By W. S. Swisher. Pp. xv+261. (London: G. Routledge and Sons, Ltd.) 10s. 6d. net.

Tables du Mouvement Képlérien. By Dr. M. F. Boquet. Première partie. Pp. vi+205. (Paris: A. Hermann et Fils.)

The Garden Doctor: Plants in Health and Disease. By F. J. Chittenden. Pp. x+154. (London: *Country Life*, Ltd.; New York: C. Scribner's Sons.) 7s. 6d. net.

Les Etoiles Simples. By Dr. F. Henroteau. Pp. xi+244. (Paris: O. Doin.) 10 francs.

In Search of the Soul and the Mechanism of Thought, Emotion, and Conduct. By Dr. B. Hollander. In 2 vols. Vol. i.: The History of Philosophy and Science from Ancient Times to the Present Day. Pp. x+516. Vol. ii.: The Origin of the Mental Capacities and Dispositions of Man. Pp. vii+361. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co.) 2l. 2s. net (two vols.).

Properties of Steam and Thermodynamic Theory of Turbines. By Prof. H. L. Callendar. Pp. xi+531. (London: E. Arnold.) 40s. net.

Early Science in Oxford. By R. T. Gunther. Part i.: Chemistry. Pp. vi+91. (Oxford: Clarendon Press.) 6s.

Application of Dyestuffs to Textiles, Paper, Leather, and other Materials. By Dr. J. M. Matthews. Pp. xvi+768. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 57s. 6d. net.

Zoomikrotechnik: Ein Wegweiser für Zoologen und Anatomen. By Prof. P. Mayer. Pp. vii+516. (Berlin: G. Borntraeger.) 64 marks.

Marine Engineering. By Engr.-Capt. A. E. Tompkins. Fifth edition, revised. Pp. xi+888. (London: Macmillan and Co., Ltd.) 36s. net.

Die Gestalten der normalen und abnormen Vogeleier analytisch bearbeitet. By Dr. A. Szielasko. Pp. v+119. (Berlin: W. Junk.)

Imperial Institute. Monographs on Mineral Resources, with Special Reference to the British Empire. Coal. By J. H. Ronaldson. Pp. ix+166. (London: J. Murray.) 6s. net.

Leicestershire. By G. N. Pingriff. Pp. xii+164. (Cambridge: At the University Press.) 4s. 6d. net.

Engineering for Land Drainage. By C. G. Elliott. Third edition, revised. Pp. xviii+363. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 13s. 6d. net.

A Text-book of Organic Chemistry. By Prof. A. F. Holleman. Edited by Dr. A. J. Walker. Fifth English edition, revised. Pp. xviii+642. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 18s. 6d. net.

Organic Medicinal Chemicals (Synthetic and Natural). By M. Barrowcliff and F. H. Carr. Pp. xiii+331. (London: Baillière, Tindall and Cox.) 15s. net.

Scurvy: Past and Present. By Prof. A. F. Hess. Pp. vii+279. (Philadelphia and London: J. B. Lippincott Co.) 18s. net.

Chemistry of Familiar Things. By S. S. Sadtler. Third edition, revised. Pp. xiii+322+xxiii plates. (Philadelphia and London: J. B. Lippincott Co.) 10s. 6d. net.

Laboratory Manual of Organic Chemistry. By Dr. H. L. Fisher. Pp. x+331. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12s. 6d. net.

Agricultural Geology. By Dr. F. V. Emerson. Pp. xviii+319. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 16s. 6d. net.

Lippincott's Quick Reference Book for Medicine and Surgery. By Dr. G. E. Rehberger. (Philadelphia and London: J. B. Lippincott Co.) 63s. net.

Diary of Societies.

WEDNESDAY, DECEMBER 29.

ANNUAL CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at Bedford College for Women), at 3.—Rt. Hon. H. A. L. Fisher: Instinct and Education.

THURSDAY, DECEMBER 30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. J. Arthur Thomson: The Haunts of Life: The School of the Shore (Juvenile Lectures).

ANNUAL CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College, Gower Street), at 3.—Dr. A. F. Tredgold: Inheritance and Educability.—At 5.—Dr. L. R. Veitch Clark: Infant Mortality: Its Causes and Mitigation.

SATURDAY, JANUARY 1.

ANNUAL CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College, Gower Street), at 10.30 a.m.—A Joint Conference on The Use of Psycho-analysis in Education.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. J. Arthur Thomson: The Haunts of Life: The Open Sea (Juvenile Lectures).

GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.—Lecture.

CONTENTS.

	PAGE
The Dyestuffs Bill	525
The Meteorology of the Antarctic	526
Imperial Mineral Resources. By **Prof. H. Louis**	528
New World Zoology	529
The Botany of Iceland	530
Our Bookshelf	531
Letters to the Editor:—	
Heredity and Acquired Characters.—**Prof. Edward B. Poulton, F.R.S.**	532
Environment and Reproduction. (*With Diagram.*)—**Prof. Alexander Meek**	532
Mode of Feeding and Sex-phenomena in the Pea-crab (*Pinnotheres pisum*).—**Dr. J. H. Orton**	533
The Energy of Cyclones.—**W. H. Dines, F.R.S.**	534
The Mechanics of Solidity.—**V. T. Saunders**	534
Needs of Polish Universities.—**Cuthbert E. A. Clayton**	535
Domestic Fires and Fuels. By **J. W. C.**	536
A Handbook to Roman Pottery. (*Illustrated.*)	537
Industrial Research Associations. VII. The Research Association of British Motor and Allied Manufacturers. By **H. S. Rowell**	538
Obituary:—	
Sir D. E. Hutchins	540
Sir Charles Bruce, G.C.M.G.	541
Notes	541
Our Astronomical Column:—	
A New Comet	546
Tables du Mouvement Képlérien	546
The Uccle Observatory	546
Colloid Chemistry. By **Prof. W. C. McC. Lewis**	547
A New Problem of Coastal Navigation. By **H. B. G.**	548
Late Keltic Remains from a Mendip Cave	549
Physiology at the British Association	549
Botany at the British Association	550
University and Educational Intelligence	552
Societies and Academies	553
Books Received	555
Diary of Societies	556

1920

. Sadtler.
ii plates.
cott Co.)

By Dr.
J. Wiley
lall, Ltd.)

sev. Pp.
ons, Inc.;
d. net.
dicine and
iladelphia
t.

Bedford Col-
er: Instinct

rthur Thom-
re (Juvenile

University
Inheritance
Infant Mor

University
nference on

rthur Thom-
Lectures).
C.1), at 3.–

PAGE

. . . 525
. . . 526
uis . 528
. . . 529
. . . 530
. . . 531

ward
. . . 532
m.)—
. . . 532
-crab
. . . 533
S. . 534
. . . 534
. A.
. . . 535
. . . 536
. . . 537
The
and
. . . 538

. . . 540
. . . 541
. . . 541

. . . 546
. . . 546
. . . 546
is . 547
B. G. 548
. . . 549
. . . 549
. . . 550
. . . 552
. . . 553
. . . 555
. . . 556